CANADA \$4.50 USA \$3.25 Vol 2 No 10

COMPUTING INTERNATIONALThe Independent Commodore Magazine

SX-64 REVEALED

ROBOTS FOR YOUR MICRO

PROGRAMS MACHINE **CODE AND** BASIC



SOFTWARE AND HARDWARE FOR PET, VICAND 64

BELGIUM FR 130 FRANCE FR 18.5 GERMANY 6DM



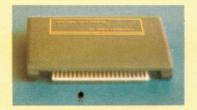


C

FROM AUDIO-COMPUTERS (SOLIDISK) THIS MONTH:

NEW LOW PRICES ON VIC-20 HARDWARE ADD-ONS AND THE INTRODUCTION OF NEW SOFTWARE CARTRIDGES

If you have already bought a memory cartridge for your VIC-20 computer, we still have many exciting items to offer, under the heading 'FURTHER EXPANSION'. They are perfectly compatible with all Commodore and many other manufacturers products.



NEW LOW PRICE ON 16K MEMORY CARTRIDGE:

NEW LOW PRICE ON 16K MEMORY CARTRIDGE:

Any program sold for the VIC-20 with 8k or 16k extra memory will run with the SRC16.

The NEW PRICE of the SRC16 is now only £27.00, including VAT and manual.

It is important to know what else you can do with the SRC16 other than running big programs.

1) The SRC16 can be upgraded to 32k bytes of RAM at a fraction of the cost of a 16k cartridge. This upgrade costs only £11.00

2) The SRC16 has an X-ROM SOCKET. Games or utilities ROMs such as SCREEN ROM or SOUND ROM can be bought separately and used in this socket. Each software ROM costs around £5-10.00.

3) The SCR16 can have an EXPANSION SLOT built in. This important fact should be noted, since many VIC users experience fitting problems and extra expense when adding a Programmer's AID toolkit cartridge or the Machine Code Monitor Cartridge to their system. With many other low cost 16k memory cartridges, the user will have to buy a multi slot motherboard just to accommodate any extra cartridges. This feature alone could save you as much as £20! The SLOT is the exact reproduction of the expansion port into which the SRC16 is inserted and will cost you only £3.00. Right now you can choose any of the extra features to be built into your SRC16 cartridge. Simply tick the option boxes shown.

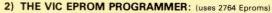
FURTHER EXPANSION TO THE VIC-20 COMPUTER:

1) 3 SLOT MOTHERBOARD:

for those for whom it's too late to buy a SRC16 cartridge or who want more than just memory. The 3 Slot MOTHERBOARD is not

for those for whom it's too late to buy a SRC16 cartridge or who want more than just memory. The 3 Slot MOTHERBOARD is not without special interest:

a) A Memory Select System allows the user to add the memory capacity of 2 RAM cartridges — for example, an SRC16 and a Commodore VIC-1111 can be used together to provide 32k bytes.
b) An optional 8k Memory System, very flexible, that will give 11775 bytes free or 6655 bytes free in the Low Res area or occasionally 8k bytes at \$A000 to \$BFFF for developing your own Autostart program can be added. Furthermore, if you then add your SRC16, you will get 28159 bytes free for your VIC 20!
c) 2 EPROM SOCKETS: this feature is very much appreciated by most users and has been added only very recently. You can use either 4k EPROMS (2732) or 8k EPROMS (2764) in these sockets. Each EPROM can be activated individually exactly as if you had 2 extra cartridges in your system!



We would need a whole page to describe this exciting peripheral for your VIC-20. Briefly, the cartridge works a little like a Disk. You can insert the VIC EPROM PROGRAMMER (VEP for short) into the SLOT and activate it with:

On the VEP, you will find 4 EPROM sockets. Now type in 'C' to display the catalog. It will show what is in every EPROM. It could be like Simply enter 'R.1' to read the first program. You will instantly see: *READING BIGBASIC *READING OK READY

1. BIGBASIC 2. UTILITY 3. AUTOSTAI 4. BLANK FPI UTILITY AUTOSTART GAME BLANK EPROM

4. BLANK EPROM READY
Now you can list it, print it, run it etc. . .
The VEP does the loading of a 16k program in about 3 seconds with no loading error unless you have a bad RAM; it will then list out all the dead or missing bytes!
To put a program into EPROM, load it from tape or disk, activate the VEP and enter 'W PROGRAM-NAME' — very simple to do. Other useful commands provided by the VEP include Hex Memory Display, Memory Change, Memory Fill, Memory Transfer, Save a Block of Memory, Load Tape, Cold Start, Centronics Printer Drivers etc. . .
You can put Basic, utility or autostart games onto Eprom in a similar way. The VEP will work out where your program is stored and will scan the EPROMs to find enough space to put it.
You can also use it as a self contained Eprom programmer to program, verify and copy Eproms.
Utility and Autostart EPROMs made with the VEP can be used on our Motherboard or on our BLANK SOFTWARE CARTRIDGES and used as any software cartridges.

used as any software cartridges.

We supply a small manual together with the VEP showing how you can write an Autostart program, in Basic and in machine code. We will also supply you with a free Blank EPROM and a free Blank Software Cartridge to get you started.

A word of warning: we have developed this equipment to help users in materialising sellable software (we are very keen to buy) and will disclaim any illegal use of it.

SOFTWARE CARTRIDGES

(insert directly into back of VIC, into Motherboard or SRC slot).

1) SCREEN CARTRIDGE: Sets the screen size within limits as small or large as you like. You can for example set the screen to 40 lines x 80 columns and a 'window' of 25 lines x 30 columns, write a letter or draw a colourful playing board and move your window with control keys or joystick. As you are typing in, the window will move along to accommodate. Basic programs can be typed in, listed and run even in 80 column format. Price £10.00.

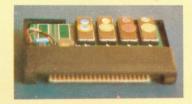
2) SOUND CARTRIDGE: transforms your VIC into an electric organ. You can play music with the keyboard, add a second voice when it plays the 1st, a 37d when it plays back the 1st and 2nd etc, define ENVELOPE to create effects like wailing police siren, play music within basic program without slowing the speed of Basic. In short, the sound Rom makes the VIC as tuneful as the BBC micro or the ATARI. Price: £10.00

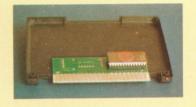
These 2 cartridges are also available in chip form. You can use the chips in the Motherboard or in the X-ROM socket of your SRC16. Price: £8.00 for either of the 2.

3) MORE CARTRIDGES will be released. We would like to market your programs in cartridge form. Alternatively, we can supply blank cartridges at very competitive prices for commercial use. We are just a phone call away so if you have a good idea, why not give us a

cartridges at very competitive prices for commercial use. We are just a phone call away so if you have a good idea, why not give us a









SUMMARY SRC16	PRICE/U INCL. VAT	*I enclose a cheque/postal order payable to SOLIDISK LTD for £: *Please charge my Access/Barclay credit card account No: (*Please delete/complete as applicable)
OPTIONAL EXTRAS FOR THE SRC16:*	611.00	
UPGRADE TO 32K		
EXPANSION SLOT:	£3.00	
FURTUED EVEN NOIGH		
FURTHER EXPANSION: 3 SLOT MOTHERBOARD:	242.05	Signature
OPTIONAL EXTRA 8K FOR MOTHERBD*		
VIC EPROM PROGRAMMER (+ free gift)	£39.00	Name: Mr/Mrs/Miss:
EXTRA 2764 BLANK EPROM:	£6.00	
BLANK SOFTWARE CARTRIDGE:	£3.00	Address:
SOFTWARE CARTRIDGES:		
SCREEN CARTRIDGE:	£10.00	
SCREEN ROM ONLY:	£8.00	
SOUND EFFECT CARTRIDGE:	£10.00	
SOUND EFFECT ROM only:	£8.00	
Post and packing:	£1.00	Please note: optional extras cannot be purchased alone. Also, if you wish to purchase them at a later date, SRCs and Motherboards must be returned together with the
		appropriate payment + £1 P+P. We regret we cannot accept orders of less than £10.00.
TOTAL:		All prices include VAT at 15%. Europe: deduct VAT, add £3.

Official UK dealers:

SUMLOCK, Manchester, Norman DAVIS, Mill Hill, GODFREY'S, Basildon, CURRY'S MICROSYSTEM chain store.

Official European distributors:

Benelux: ECD, Delft Tel 015 134429.
France: RUN informatique sarl, Paris Tel (01) 581 5144.
Germany: VOBIS Data computer GMBH, Aachen Tel (0241) 50 00 81.
SCHAEFER, Roetgen Tel (0240) 88 319.
Italy: SOLIDISK Italia, Inglesias (CA), Tel 0781 22529.
Portugal: LANDREY Engineering, Lisboa Tel 681243.
Sweden and Norway: DIGILOG, Goteborg Tel 031 20 29 00.

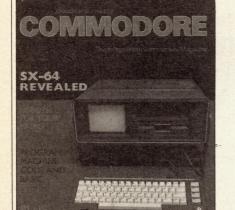
Thank you for the interest shown. Marketing Manager: H. PERRY

TO: SOLIDISK TECHNOLOGY LIMITED (T/A AUDIO COMPUTERS) **87 BOURNEMOUTH PARK ROAD** SOUTHEND ON SEA ESSEX SS2 5JJ UK

OUR TELEPHONE NUMBER: CREDIT CARD SALES **DEALER ENQUIRIES:** 0702 618144

ENQUIRIES: 0702 613081

COVER STORY



The SX-64, Commodore's new portable version of the 64, is put through its paces in this issue.

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COMPUTING INTERNATIONAL

MARCH 1984

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RUNNER-UP PRIZES!

Devise a totally original new video game in one of these categories: SPORTS, SIMULATORS, ARCADE, STRATEGY, ADVENTURE/FANTASY or a special section which covers programmes that are not necessarily games but have outstanding Educational or Entertainment merit. We'll also be announcing a number of 'MERIT' awards which will be

entitled to carry the message 'An International Video Game of the Year MERIT AWARD' on their retail packaging. It's a great challenge. And the rewards, both financially and in terms of prestige, are tremendous. This is the most exciting competition ever for creative computer and video enthusiasts

All six winning games and their inventors will be featured on an internationally distributed. spectacular TV special. That's going to make your name!

31st MAY 1984

To: IRP Limited, Pinewood Film Studios, Iver, Bucks, England.

Name		
	-	CC1

Record sales as Tramiel quits

Just days after Commodore announced record worldwide sales for this calender year, the resignation of Jack Tramiel, founder and Chief Executive of Commodore was announced.

He will be succeeded by Marshall F. Smith, president and chief executive of Thyssen-Bornemisza Inc who took up the post on February 21, 1984. Mr Smith is known to be an excellent businessman and has a history of successful management in industries

both in the USA and Europe.

Worldwide, Commodore sales went up to \$1 billion this calender year compared to \$50 million seven years ago. Commodore (UK) contributed substantially to this and in 1983 they sold over 750,000 compu-

Jack Tramiel's long career with Commodore has seen phenomenal expansion and he will continue to assist the company as a consultant and adviser.

Pirate threat to software

It is estimated by the British Guild of Software Houses that for every single game sold, up to ten pirate copies are made. An estimate that is increasingly worrying software publishers, especially as the value in lost sales amounts to at least £100 million!

Most of the 300 or so British software houses are hit by this illegal competition and stand to suffer losses, so plans are afoot to devise ways of combating the problem.

For further information contact Nick Alexander, Virgin Games, Tel: 01-221 7535.

Debut for Mycomp

A personal computer show, called Mycomp, is being held on November 1-4 in the Fulcrum Centre, Slough. Organised by Swan House, the Slough Corporation and the centre itself, the show is hoping to attract schools, families and businessmen.

Contact: Steven Mindel, Thames Meadow, Walton Bridge, SHEPPERTON, Middlesex. Tel: 0932 243866.

Wanted

Now is the chance for whizz kid computer game inventors to prove themselves, K-Tel, following the success of their initial launch into the computer software market, are looking for more ideas.

They are especially interested in games for the Commodore 64 and are looking for inventive, original and fun ideas. The best games will be selected for marketing. Interested parties should contact Mike Dixon, K-Tel International, 620 Western Avenue, LONDON W3 0TU. Tel: 01 992 8055



Six new games from America have been imported into the UK by Centresoft. Zaxxon, Pooyan and O'Riley's Mine retail at £14.95 and the other three are selling for £9.95.

Camps compute

Parents anxious to introduce their offspring to the computer world should consider Camp Beaumont, Courses are designed for complete beginners as well as the eager expert and are supervised by professional staff.

Courses in the curriculum include Logo, Basic for Beginners, Intermediates and Advanced programmers, Machine Code, word processing etc. A number of sports and other recreational activities fill the gaps between computer classes.

The Camps are based all around the country and the prices range from £58 for 3 days to £118 for 7 days. Both prices exclude VAT.

Contact: Beaumont Computer Workshops, 73 Upper Richmond Road, LONDON SW15 28Z, Tel: 01-870 9866.

New HQ

Recent expansion has prompted Intelligence (UK) to move from their Wimbledon Offices to Network House, Ariel Way, Wood Lane, London W12.

Join the

Two new Commodore user clubs are the Wigan and North Gloucestershire Computer Clubs. They are both oriented to Commodore products; Pet, CBM 64, Vic 20 and their peripherals. In the very near future, Commodore Computing International will be publishing a special feature on Commodore clubs in the UK and elsewhere and welcome any information people have on their own clubs.

Contacts: NORTH GLOS CLUB, RC Harvey. Tel: 0242 527588 and WIGAN CLUB, AF Owen. Tel: 0942 212662.

PRODUCT NEWS

Cross compile

Cross Compilers for the CBM 64 and the 700 are now available from Oxford Computer Systems. The cross compilers enable programmers to generate object and source codes on the 8000 series from the CBM 64 and 700 series respectively.

For the 700 series, the two products involved are the Bport, a version of Petspeed and the X-700, a version of the Integer Basic Compiler, Both are supplied on disk, retailing at £450 each.

The two cross compilers for the CBM 64 are the Portspeed, a suite of programs and the X-64, an integer compiler. Both are supplied on disk, retailing at £150 each.

Contact: Oxford Computer Systems, The Old Signal Box, Hensington Road, Woodstock, OXFORD OX7 1JR. Tel: 0993 812700.

Micro music

Musically-minded 64 owners will be interested in the full size keyboard, retailing at £130 + p&p from Autographics Ltd.

No external power is needed for this 4 octave C-to-C keyboard. It has two user definable sliders and an expansion slot allowing for developments. The controlling software is menu driven and simple to use, giving the user complete control of all Sid Chip parameters. Envelope Parameters are graphically represented and sounds can be recalled and stored.

For use with a cassette or disk and additional programs are available including sequencing and tuition.

Contact: Autographics Ltd, 3A Reading Road, HENLEY, Oxon, RG9 1AB. Tel: 0491 575469.



SX-64 arrives

The Commodore SX-64 portable, the executive version of the 64 is now available in the UK. Aimed at the businessman, salesman, and anyone who has to travel, it costs £895 including four free software packages.

The SX-64 can be transported and set up any where with a mains power outlet. Incorporated into the set is a 5 inch colour monitor, a 51/4 inch floppy disk drive and the detachable keyboard doubles as a lid. Commodore claims that it could be used in the 'home', but although it has a port for paddles, joysticks, lightpens etc it has no cassette interface

Demand for this product has outstripped its supply, but Commodore are flying them over from the USA on a monthly basis.

High score competition

Livewire have produced three new games; Gridtrap, Jumpin Jack and Triad for the CBM 64, costing £8.95 each.

A 'High Score Competition' Entry form comes with each game giving players an extra incentive to score points. Any claim should be submitted with the form for validation. First prize is a Commodore 1541 Disk Drive. Second prize is a Commodore 1520 colour printer plotter. Third prize is a Simons Basic package and the seven runner-up prizes are pro-ace competition joysticks.

The closing date for the competition is March 1 1984.

The three games will appeal to all age groups and 3D dimensional graphics have been used to inject the games with new perspectives. In October of this year Sumlock will be introducing the Pro Ace Joystick designed for the Vic 20 and CBM 64. Costing £12.95, its 2 year warranty is some indication of its reliability.

Contact: Sumlock Microware, 198 Deansgate, Manchester M3 3NE. Tel: 061-834 4233

Supercat

Two catalogues specialising in electronics, industry and research in general have been issued free by Supercat Electronics Ltd.

The January issue of the Electronics catalogue covers measuring instruments, leads, connectors, accessories and kit among other things. The direct mail catalogue deals with Multimeters, Oscilloscopes, Meggers and much more. The next issue will be coming out in the summer.

Contact: Supercat Electronics Ltd, PO Box 201, St Albans, Herts, AL1 4EN. Tel: 0727 62171.

First



Micro Peripherals Ltd have brought out what they claim is the first all-in-one British built colour monitor - the CM14 for

The 14 inch colour monitor is compatible with Commodore machines and can receive RGB, RGBY, PAL COMPOSITE and audio signals.

Contact: Micro Peripherals Ltd, 69 The Street, Basing, BASINGSTOKE, Hants. Tel: 0256 3232.

More than fun and games!

CÆSAR THECAT

by Andromeda Software

ou will have more than fun and games when you meet Caesar, a cheeky young cat on duty in a well-stocked

larder. He's kept busy chasing a gang of hungry mice eating the family's food. Playing against the

clock, you guide Caesar along crowded shelves to pounce on the mice.

A fast, colourful, all-action.

arcade-style game which is winning praise from reviewers.

'A marvellous, truly addictive game which also manages to be original, it has few peers.' **Popular Computing Weekly**

'It's not possible to compare this game with anything I've seen before . . . Excellent.' **Soft**

'Lovely graphics, and a fine entry into the market from Mirrorsoft.' **Which Micro**

There's catchy music and a best-score record. Caesar the Cat is a challenge for high-scoring arcade addicts (has anyone reached a score of 10,000 yet?) as well as great fun for the novice.

Available on Cassette for the Commodore 64.



QUEK THINK

by Widgit Software

wo mind-stretching, space-age games to test mental arithmetic and nimble fingers.

In **Sum Vaders** alien robots invade the earth. Only quick thinking and fast reactions can prevent them. Several levels of difficulty and a two-player game with a handicap option make Sum Vaders equally testing for all family members, from 8 years to adult.

Robot Tables challenges the young player to make a series of perfect robots. With a learning mode and a testing mode this game is a fun way for early learners, and more advanced children, to master their multiplication tables.

Available now on cassette for the Commodore 64 (and also the Spectrum 48K, BBC B and Electron).

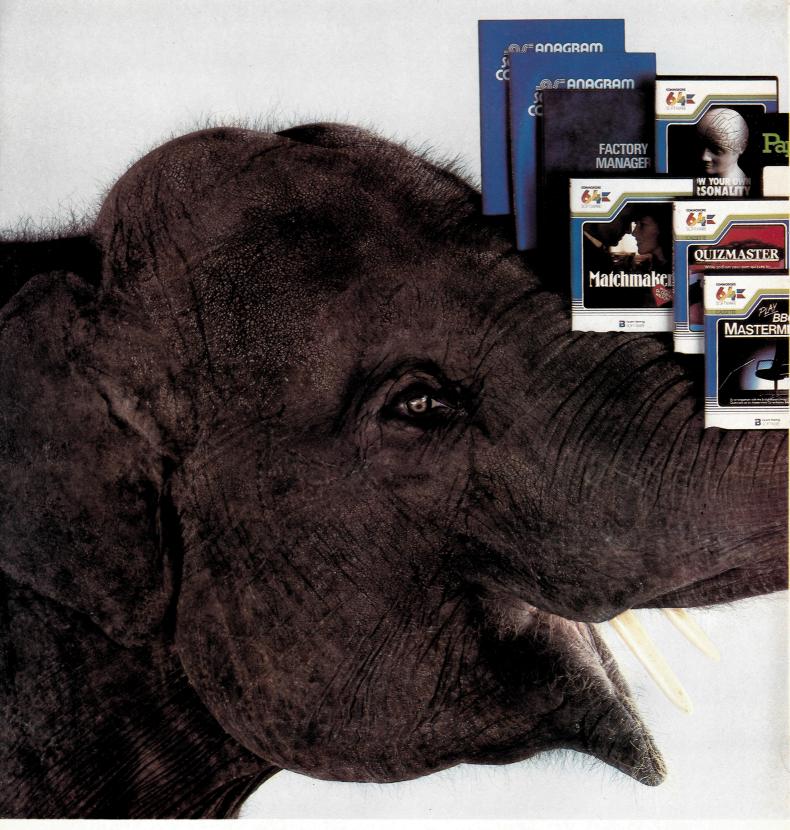
MIRRORSOFT programs are available from selected branches of W.H. Smith and Boots, and other leading software stockists. Trade enquiries welcome: phone 01-822 3580.



SOFTWARE FOR ALL THE FAMILY

To MIRRORSOFT, PO Box 50, Bron Kent BR2 9TT Please send me the following (ent	er	l en to "	close a che Readers' A	eque/PO fo account: Mi	r £ rror Group	made payable Newspapers Ltd". Lunderstand that my	Or please debit my ACCESS/BARCLAYCARD for the sum of £ card no CI1
number required of each item in the space provided):	Price	Spectrum 48K (01)	BBC B (03)	Electron (04)	CBM 64 (05)	remittance will be held on my behalf in	Signature
Quick Thinking (QT01)	£6.95					the bank account named above until	Name
Caesar the Cat (CCO1) Prices include VAT and post and packaging	£8.95					the goods are despatched.	Postcode

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The problem with many home computers is there's often very little software to go with them.

Or all that is available is games, games and

more games. There's no such problem, however, with the Commodore 64. It has a more extensive range of serious software than any other home computer.

It also has an unusually large (in fact elephantine) 64K memory, as well as every peripheral you're ever likely to need.

All of this means you can run more interesting,

entertaining and complex programs. You can teach yourself many different subjects, even computer programming. There are programs for the office and, when you're mentally exhausted, yes, there are even games.

However, we have to admit that in one respect the Commodore 64 does fall short of the competition. It costs around £229, much less than any

comparable machine.

And that's one fact we hope you'll never forget.



When you have an enormous memory there's no end to the things you can do.

Please send me further information on: the 64 computer
64 software disk drive cassette unit printers monitor
Name (Mr. Mrs. Miss)
Address

Send to: The Commodore Information Centre, 675 Ajax Avenue, Slough, Berkshire SL1 4BG. Or telephone (0753) 79292.





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from the producers of



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our Star badge by clearing the Galaxy of hostile forces like Cosmic Kamikazes, Galactic Pirates and hazards like Space Minefields and Meteor Storms

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Stop the tank exploding by plumbing in a relief pipe using your skill and ingenuity. Avoid the rocks and beware the ghost!

Fun-action game for Commodore & 178







TERMINAL SOFTWARE 28 CHURCH LANE, PRESTWICH, MANCHESTER M25 5AJ. Telephone: 061-797 3635 or 061-773 9313

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CentreSoft WEST MIDLANDS Selected Lewis's and Co-op Stores

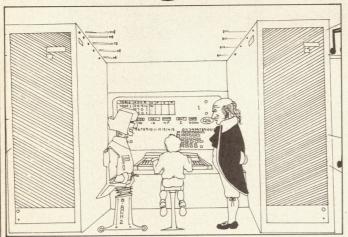
SoftShop





PRODUCT NEWS

Making music



Aspiring musical composers will welcome Ultisynth 64, Quicksilva's new music processor. Priced at £14.95 the package includes an instruction manual.

Musical programs can be composed note by note and all the sounds of the orchestral instruments can be synthesised - piano, strings, woodwind, percussion etc. These

be played alone together. For dramatic effects trains, thunder, flying saucers can be added.

Special features include four wave forms, modulation, synchronisation, editing facilities and three voices.

Contact: Quicksilva Ltd, 13 Palmerton Road, SOUTH-AMPTON, Hampshire SO1 1LL. Tel: 0703 20169.

Sony TV



Sony have launched the KV1430, a 14 inch colour television specially designed for use with the home computer, retailing at £249.

The computer unit can be plugged into the RF socket on the front of the set and linked directly to the TV screen providing an instant connection for games etc. Vertical styling of the screen enables easier viewing.

The KV1430 is available from Sony dealers all over the country.

The Petcomm launched recently by Cortex Computer Systems Ltd enables one PET to communicate with another on a local or remote basis.

The package provides facilities for simple file transfer; error checking; file existence and disk capacity checking; relative and sequential file handling and file editing. The Petcomm is suitable for both floppy and hard disks.

Three versions are available: the Starter Kit retails at £970 and contains an operating manual, a 12 month warranty, 2 floppy disks and 2 interfaces. In addition there is the add-on package for existing Petcomm users at £695 and a second configuration with software costing £265.

Contact: Cortex Computer Systems Ltd, Cortex House, 5 Union Street, BEDFORD MK40 2SF. Tel: 0234 217721/2.

Education offensive

Commodore has launched a campaign to monopolise the hotly contested Education market. By offering computer systems with substantial discounts to schools they hope to present themselves as the viable alternative to other products

This move coincides with the end of the Governments assisted purchase scheme which encouraged schools to introduce computers (what a

The package comprises the CBM 64, 1541 single floppy disk drive, LOGO (an advanced computer-aided instruction language) and Simons Basic 1 (programming aid). They are offering it to educational establishments for £299.99, a saving of £170. The offer is open until April 30, 1984.

Contact: All approved Commodore dealers in the IIK

lunchback

'Hunchback' the popular arcade game has been released by Ocean Software Ltd in program format for the CBM 64. Retailing at £6.90 it can be played with a keyboard or iovstick.

The game has fifteen levels of difficulty and Quasimodo's aim is to rescue Esmeralda from imprisonment in the castle.

Contact: Ocean Software Ltd, Ralli Building, Stanley Street, MANCHESTER M3 5FD.

Tel: 061 832 9143/7049 and all major software outlets.

Printer/plotter



has been designed by Micro capacity and a printing speed Peripherals Ltd for the home computer. Priced at £113 excluding VAT.

to the CBM 64 the plotter can BASINGSTOKE, Hants. Tel: print out graphs and charts in 0256 3232.

A printer/plotter, the MCP-40 four colours. It has a 80 column of up to 12 characters per second.

Contact: Micro Peripherals By interfacing the MCP-40 Ltd, 69 The Street, Basing,

Starcade presents

SAVAGE POND

ATARI™ COMMODORE 64™



A truly remarkable depiction of life cycles in a freshwater environment. A semi-educational programme with high resolution graphics, crammed with thrills, spills and excitement, featuring:

Amoeba (Rhizopoda); Hydra (Chlorohydra Viridissima); Dragonfly (Erythromma Najus); Bloodworm (Phylum Platyheminthes); Jellyfish (Craspedacusta Sowerbeii); Beetle Larva (Macroplea Leachi); Spider (Argyronata Aquatica); Water Fleas (Scapholeberis Mucronata); Bumble-Bee (Bombas Lapidarius); and our special guest star

THE COMMON FROG

(Rana Temporaria)

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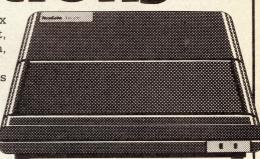
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- Which Micro?, Feb 84

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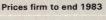
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HARDWARE REVIEW

SX-64 REVEALED

This month we got our hands on the SX-64, the portable version of the 64, and put it through its paces to discover its good – and bad – points.



Commodore Computing Path

At last the SX-64, the portable version of the Commodore 64, has reached UK shores. It has, of course, been available in the US for some time – our thanks to those US readers who have had a chance to get used to the new machine and offered us their comments.

If you're expecting something that looks even vaguely like the full size 64, forget it. Apart from the Commodore

logos here and there, at first glance there's nothing to indicate the two are even related. Those 64 enthusiasts who have developed an affection for the machine which even extends to the muddy brown colour might be offended by the dark grey colour of the SX-64.

It measures 14.5 inches square and is 5 inches deep and weighs approximately 10.5 kilograms. A carrying handle acts as a support when the computer is set up. The keyboard doubles up as a lid which covers the monitor screen and the disk drive slot. On our model we found the catches on the lid a little tricky and if you weren't careful, or on the other hand if you were a little careless, you might lose the lid. It is very simple to set up — there's just one connection between the keyboard and the main body of the

ARDWARE REVIEW

computer through a 25-pin lead and apart from that all you have to do is to plug it in and switch on.

So far, so good. But now you start to encounter problems. None of the problems is, it is true, all that serious and many of them are inevitable - caused by restrictions imposed by the computer's portability. It's unfortunate that, since the 64 has already been fully reviewed, reviewers can only look at what's new about the portable. This means that many of the good points which are common to both machines get passed over while the bad points of the portable are highlighted.

Suffice it to say that we at Commodore Computing International are great supporters of the Commodore 64 and believe there's no better computer for the price. All the advantages (and disadvantages) of the electronics of the big brother are present in the portable.

Our office desks are not noticeable for their remarkable shine but the SX-64 keyboard displayed an irritating tendency to slide around. We also found the keyboard a little less easy to use than big brother's. It's a smaller keyboard, very compact and the 67 keys appear to be slightly closer together and less steeply raked.

The 5 inch screen, although a full colour monitor, must be regarded as purely functional. It would be unwise to buy an SX-64 with the idea of using the built in monitor all the time. It's far too small for any prolonged serious use but is good enough as a temporary stop-gap.

The screen shows the standard 40 column display but it can be used as a window to handle 240 columns. The colour capabilities of the SX-64 are exactly the same as the standard 64. Colour, contrast, brightness and vertical hold are controlled by buttons located on the right of the front panel. The volume control is also found here.

The disk drive is basically a built in 1541 - a 17K, 5.25 inch floppy disk drive. What we fail to understand about the disk drive is why it interfaces in the way it does with the computer inside that nice grey exterior. Apparently the disk drive interfaces with the computer in exactly the same way that the 1541 interfaces with the big brother 64. It seems to us that an opportunity was lost here to speed up the disk drive. As everyone who owns a 1541 knows it is notoriously slow. Above the disk drive is a large slot marked storage. It's useful for storing the leads and may, perhaps, be useful for storing disks.



The SX-64, all packed up and ready to go!

At the back of the SX-64 is the usual array of two DIN plugs, an edge connector for a printer, two A-D interfaces and, of course, the on/off switch. A ROM cartridge interface can be found on top of the machine.

Where, you may ask, is the cassette interface? The answer has surprised most people - there isn't one. But the SX-64 is, after all, a business machine. The vast majority of business software is on disk. Can any business software that's on tape only and not on disk really be serious? And businessmen aren't expected to play games on their #900 computer. Unfortunately you do get the impression from the literature that the portable is a great idea because you can take it home with you the end of the day and the rest of the family can enjoy it.

While reviewing the SX-64 we began to question the whole idea of portable computers. The truly portable computers are a terrific idea. Tapping away at a keyboard on your lap in a crowded train compartment not only creates a great deal of interest (in the UK at least) it really does enable you to do work in circumstances which would usually be too inhibiting.

But there are a number of 'portable' computers which would more accurately be called transportable. They won't work without a mains supply and therefore cannot be used while you're on the move. The photographs that accompany the literature show scenes that give the impression that SX-64 is truly portable. There's a suitably macho man standing in the middle of a building site carrying his SX-64 - and not an electrical supply in sight.

Who will use the SX-64 and computers like it? And why would they buy the SX-64 rather than the big brother 64? There are obviously the people around who want the machine since Commodore say they are selling well - they had 1,500 pre-Christmas orders.

We could not come up with one absolutely, undeniable, concrete reason why the portable was a better bet for any of us than the full size version. We had this nagging feeling at the backs of our minds that Commodore had not put a tremendous amount of research and development into producing a really good portable computer. It's rather as if they said to themselves: 'Hey - what if we stick the 1541 disk drive in a box with the computer parts of the 64, then add a little monitor, copy Osborne and put a keyboard in the lid? That'll give us a nice portable without all the bother of all that research and development."

SX-64 Modifications

We have made a comparison between the ROM's of the 64 and the ROM's of the SX-64. Following is a list of the differences between the two systems.

There are no alterations to the Basic ROM.

We have found that there are quite a few modifications to the kernal ROM however.

ADDRESS ALTERATION.

58489-58515 The Power up message has been altered to give sx-64 instead of commodore and v2.0 replaces v2.

58540 Also in power up message.

58579-58588 Added routine replacing blank memory.

58677 New Cursor colour (Blue instead of Lt. Blue).

58748-58869 Set screen pointers routine. 58863 Input from keyboard routine (branch).

58868-58869 New address for SHIFT/ RUN-STOP.

58914-58915 New address for retreat cursor routine.

59911-59922 Modification to clear screen line routine.

60633-60634 New default border and screen colours.

61332-61334 Jump from routine to added routine at 58579.

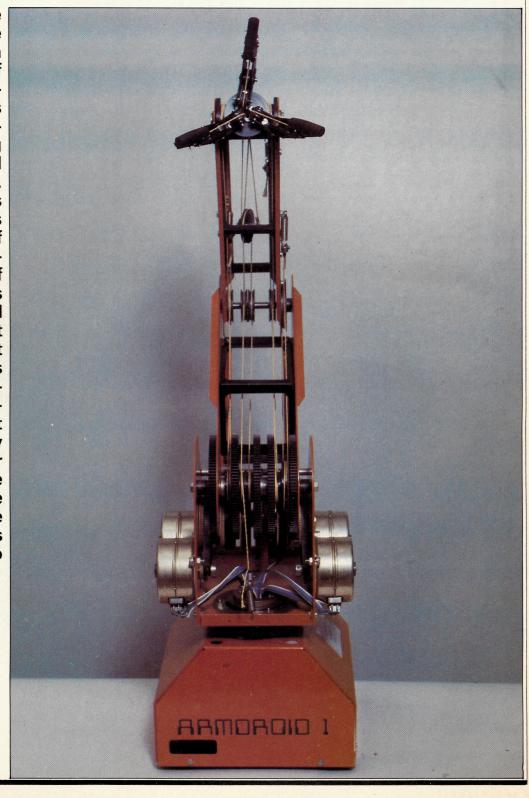
61656-61670 String for SHIFT/RUN-STOP: 'LOAD ":*", 8 < ret > RUN < ret > ' replaces the now useless command of '<ret>PRESS PLAY ON'.

62343 Modified branch in open file. 62647 Low byte of a jar in load routine. 62969 Branch in save routine.

ROBOTICS

Getting to grips

Once every couple of months the media get hit by a massive dose of robot mania. Suddenly newspapers and TV programmes are predicting the end of manual labour for humans. The evidence for this rash prediction is usually the launch of an inordinately expensive bundle of plastic and wires that trundles around so clumsily that you'd never trust it with something as valuable as a Martini. With recent launches of robots that can be controlled by a home computer such as the 64 we thought it was time we looked at the sort of robotics that's accessible to the general public.



with Robotics

The public has been made aware of the current capabilities of robotics through news of manufacturers such as British Leyland using robots in the production line, and through robots used for promotional purposes at exhibitions. Even the Prime Minister recently came face to face with a robot at a conference hall where she was greeted by a bespectacled robot complete with bowler hat saying "Good morning Prime Minister, how nice to meet you."

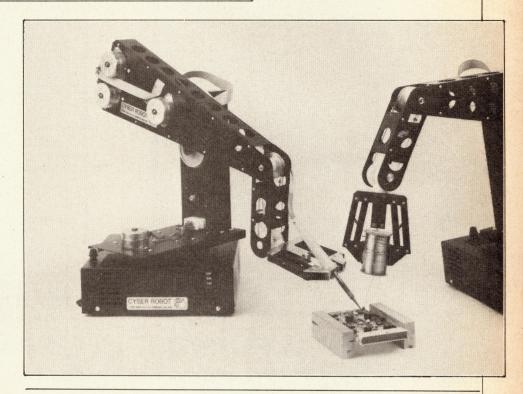
People have also been given a tantalising futuristic look at robots through such lovable robotic characters as Star Wars hero C3PO.

Techno-fear is an expression often heard when new technology is discussed, but it wasn't the reason behind the refusal of American casino chiefs to install a robot croupier. They were worried that it could learn to cheat customers!

Many people dream of having their own personal robot slave to perform all those tedious household chores and to wait hand and foot (should that be wheel?) on them. Unfortunately it will be many years before these dreams can be realized. However, less sophisticated forms of robotics are accessible to the public. Robot arms, for instance, are an interesting introduction to the world of robotics and a number of companies are coming out with robot arms that can be driven by popular micros like the 64, at a price within reach of the general public.

The brightly coloured robot arm pictured here comes from Colne Robotics and is available in kit form for around £400. Called Armdroid, it rather resembles a toy crane. It won't do the cleaning or make the tea, but it can be programmed by your computer to do simple tasks like picking up an object and moving it from A to B.

Colne Robotics' Armdroid is a relatively simple but ingenious robot arm. Perhaps it's a little beyond the pocket of the average micro owner but at around £400 for the kit it's ideal for educational purposes. Nearly everything is showing - all the cogs and gears are visible so it's easy to see how it works mechanically and, in spite of the brightly coloured sheet metal from which the casing is made, it does look, in some respects, a little like a string driven thing. But what looks like string is, in fact, special carbon



Cyber Robotics' robot arm, the Cyber 310, is pictured above demonstrating the accuracy to which a robot arm can be positioned. Operating along the same principles as Colne's Armdroid, Cyber Robotics' arm emulates a full-size industrial robot. It's operating system is an extension of FORTH which permits speed control. Slow movements allow close analysis or critical control.

fibre, enormously strong and almost impossible to stretch.

Like most examples of robot arms this one uses stepper motors which receive the instructions from the computer. The Armdroid has five such motors and on the printed circuit board that makes up the interface, hidden at the base of the arm, there are also five chips. Each chip send instructions to one of the motors. There is also some overall control of the arm.

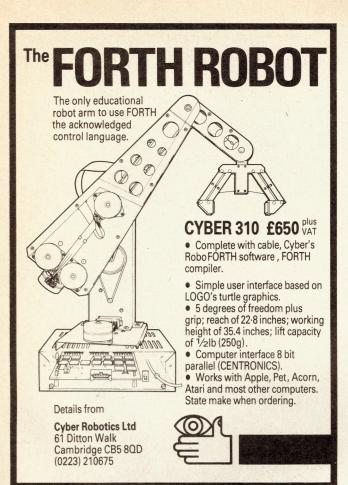
Stepper motors, of course, move step by step. The size of each step is predetermined and the number of steps taken depends on the amount of current applied and the period for which it is applied.

Another robot arm on the market is the Cyber 310 from Cyber Robotics. At around £650 the Cyber arm is more expensive than Armdroid and uses an

extension of FORTH called ROBO-FORTH. This permits individual complex motions to be learned, combined and played back allowing the user to understand what is happening without the assistance of a computer expert.

Cyber 310 has five degrees of movement, a programmable gripper action and the ability to rotate the shoulder 300 degrees in the vertical plane to operate on the opposite side with the arm upside down, giving the robot greater flexibility.

One of the major setbacks with most robots is that they cannot 'see'. Move an object a few inches away and it won't be able to find it. Dr Peter Davev has developed a robot that can see, using a laser and tiny television camera in the 'business' end of the robot. The laser provides a brilliant flat illumination so the robot is not confused by varying



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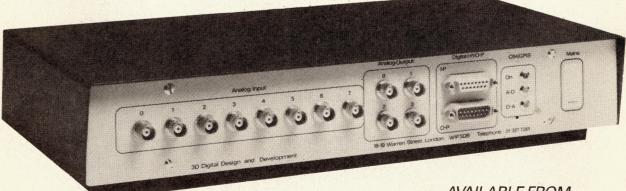
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ROBOTICS

shades. This is particularly useful in industry where the robot needs to remain on target. Davey is now programming the robot to inspect and touch up shoddy work.

There are robots on the market which do have the appearance people have come to expect from a robot. Not humanoid by any means, but with friendly looking 'faces'. They perform some basic functions, but can really only be described as a very expensive toy out of the average man's financial reach.

Prism have recently launched two personal robots, Topo and FRED (Friendly Robotic Educational Device). Topo is three foot tall and will cost you around £1,500. He (she? it?) is controlled via a personal computer or joystick. A wireless infra-red communications link relays information from the computer to Topo. Topo is capable of speech and movement, but is by no means stable enough on its feet (in this case two independentally driven wheels) to carry your drinks to you without spilling a drop.

FRED looks more like Dr Who's trusty companion K9 and, at just over one foot high, performs on a table top or on the

Retailing at around £200, FRED comes complete with a portable infrared remote control although it may also be operated via a personal computer.

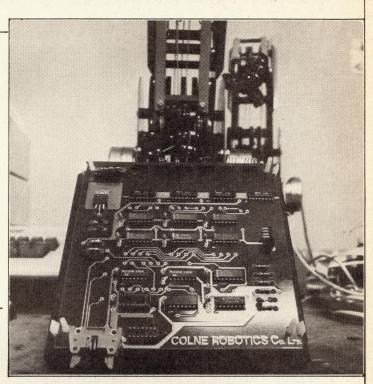
A drawing pen attachment allows the user to create patterns on a computer screen which can then be translated onto paper by FRED. Like big brother Topo, FRED can speak. A 45 word vocabulary is optionally expandable.

Although primarily a toy at present, Prism's plans for the future include applications such as intruder detection, smoke detection, hoovering/ lawnmowing, and fetching and carrying for invalids.

Hoover have produced a remote control vacuum cleaner which is operated by a joystick similar to the ones used in playing computer games, and hope to be able to include a programming facility which will enable the machine to find its own way round the room. However, these are not likely to appear on the market just yet as even the remote control model would cost up to four times as much as the latest push-around models.

So keep dreaming about your own personal robot slave, but for now why not consider an introduction to robotics through the sort of robotics currently accessible to the public such as a robot arm.

The printed circuit board of Colne Robotics' Armdroid, pictured right, contains a userport compatible interface and the logic for controlling the direction of movement and the selection of which stepper motor is to be activated. It also contains the drivers to power the motors once it has been decided which way they are to move.



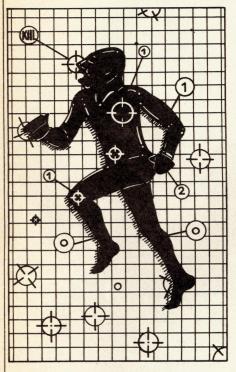


Colne Robotics' latest venture is a lathe. Once again it's designed especially for educational purposes. It can teach newcomers to the lathe how any lathe works but especially how a computerised lathe works. The piece to be turned can first of all be designed on the monitor and can be viewed as a three dimensional object. It is therefore possible to see exactly what the finished piece will look like before work starts.

The lathe is designed to interface to any parallel port 8-bit micro. The software that Colne Robotics supply provides a comprehensive range of G-codes and the facility to accept and retain complex cutting sequences. The lathe is the first in a planned range of educational machine tools

Enter Zorgon's Kingdom

An assortment of new games for the VIC-20 and the CBM-64 this month, from the usual 'zap! pow!' variety to an adventure game rumoured to be so hard that the manufacturers supply a free clue!



Zorgon's Kingdom

Zorgon's Kingdom is one of those games that is so frustrating the player has to keep on playing and playing until the game is mastered. This new game from Romik is played on the VIC with 8K or 16K expansion.

Zorgon's Kingdom is not an adventure game although the title suggests that it is. Neither can it accurately be described as an arcade game. It is really a cross between the two. It is an adventure in that the player has to get to Zorgon and kill him by shooting him on the nose when his mouth is open, and an arcade game in that to actually get Zorgon, the player has to avoid holes, rolling bombs, rockets and aliens.

The game itself is split into five sections and, naturally, to progress from one section to the other each screen has to be completed successfully.

The graphics are quite good although the movement of the sprite is sometimes a little slow.

Title: Zorgon's Kingdom Programmer: Chris Stamp

Company: Romik Software, 272 Arayll Avenue, Slough, Berkshire Type of game: Arcade/Adventure Graphics: Quite good. Movement is

a bit slow

Hardware required: VIC with 8K or 16K, television or monitor, cassette player, joystick (optional)

Description: Successfully complete the five sections of this game and kill

Price: £6.99 including VAT, post and

packaging CCI rating: ***

Millie-bug

The idea behind Millie-bug, a new game for the Commodore 64 from Dk'tronics, is to destroy as many of the bugs as possible. It is very similar to Exterminator and imitation is the sincerest form of flattery.

Millie-bug has nine skill levels although the first five are not worth bothering with because the action is slow and rather

The graphics are fairly good, especially on the introductory screen and the sound effects are quite realistic. These cannot and do not make up for the lack of excitement and speed in other areas of the game. To get the maximum enjoyment from the game the user should go straight to level nine and stay there.

The program is recorded on both sides of the cassette.

Title: Milie-bug

Company: Dk'tronics, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AX, Telephone 0799 26350/222359

Type of game: Arcade Graphics: Average

Hardware required: 64, cassette recorder, television and a joystick Description: Kill the catterpillars Price: £5.95 plus 50p for post and

packaging CCI rating: ***

Snooker

Snooker is a machine code one or two player simulation game that runs on the 64. Control of the game is either by keyboard or by joystick and after the game has been loaded a check is run to see if a joystick is attached.

If there is not a joystick attached, it is assumed that the keyboard is the input medium with the cursor and the S key moving the cue and the cue ball. For firing use K.

It is possible to play a 15 or 10 ball game and the first break is made by positioning a '+' at a user defined position. This cross represents the line the cue ball will take to the target point. The actual strength of the shot is determined by the length of time the fire button is held down.

The best feature about this game is the ability to put spin on the cue ball. To do this all the player has to do is move the joystick or cursor in the direction of the spin, pressing the fire button at the same time. Release the fire button but continue to press the joystick.

Whilst putting spin on the cue ball is a very nice feature, the movement and sound of the balls leaves something to be desired. The balls often move guite slowly and when they actually touch, the sound is definitely not ivory or hard plastic. It is more like a fire cracker that has gone wild.

That is the only bad point of a game which includes all the features of a normal game of snooker and has some good hi-resolution graphics.

Title: Snooker

Company: Visions (Software Factory) Limited, 1 Felgate Mews, Studland Street, London W69JT

Type of game: Simulation

Graphics: Good

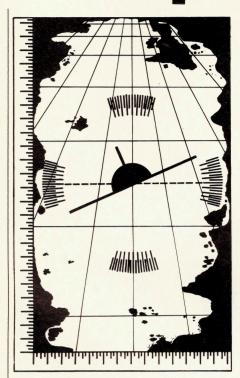
Hardware required: 64, cassette recorder, television and a joystick (optional)

Description: Snooker

Price: £8.95 including VAT and post

and packaging CCI rating*

-then pot the black



Flight Simulator

The object of the Flight Simulator from Anger Productions is to fly an aircraft from Heathrow to any of eight destinations within the UK. It is a pity that more was not made of the capabilities of the 64.

In all, there are three separate screens. All of the destinations are displayed on a map of the UK which can be displayed at any time and there is a screen showing the current grid reference of the aircraft. The final screen is that of the actual cockpit and on this screen the player is presented with the compass controls and all the flight indicators.

There are three phases to this game, the first being the take-off phase where the player decides on the destination and must get the speed up to at least 130 knots. The second phase is when the aircraft is actually airborne and the user is given cockpit prompts and warnings - the worst thing that can happen is allowing the speed to fall below 60 knots which results in a fatal nose dive. When airborne, you must fly to the exact map reference before making any attempt to land.

The game makes quite an interesting diversion without being too taxing on the brain or reflexes.

Title: Flight Simulator

Company: Anger Productions, 14 The Oval, Broxbourne EN10 6DQ

telephone 0992 461156 Type of game: Simulator **Graphics:** Average

Hardware required: 64, cassette recorder or disk drive, television,

joystick (optional)

Description: Fly the airplane! Price: £9.95 cassette, £11.95 disk

CCI rating: * * *

Ship of the Line

Ship of the Line is a new strategy game for the 64 which takes the player back to the days of the 17th century and many naval battles in the Mediterranean.

The whole point of the game is to gain promotion from midshipman to First Sea Lord. This is done by winning the favour of your superiors and winning as many naval battles as possible.

There are, however, other factors which must be taken into account. The player must ensure that there is adequate supplies of food, water, ammunition and enough crew to man the ship. If not, the player may be forced to surrender in the middle of a battle or be murdered by his

As the game progresses, the crew of the ship gets bigger as does the supply of ammunition and enemy forces but a major disappointment in the game is the poor use of the 64's graphic capabilities. The basic screen is that of an horizon with a few clouds and enemy ships. The actual battles are graphically unexciting leaving a lot of room for improvement.

Title: Ship of the Line

Company: Richard Shepherd Software, Elm house, 23/25 Elmshott Lane, Cippenham, Slough, Berkshire,

Telephone 06286 63531 Type of game: Strategy

Graphics: Poor Text: Average

Hardware required: 64, television,

cassette recorder

Description: Wage war on the high

seas and gain promotion

Price: £6.50 including VAT and post

and packaging CCI rating: ***

Snowball

Anybody coming across the game called Snowball for the first time might assume that the game was all about winter sports. Snowball is in fact a textual adventure game that takes place in space. It uses a massive 32K of the 64's memory and the aim of the game is to ensure that the starship Snowball docks safely with the target planet of Eden

The big question is how do you avoid the deadly nightingales as soon as you

manage to get out of the coffin?

Level 9 Computing claim that the game has well over 7000 locations and 60 objects. The budding astronaut has to solve a large number of puzzles while finding his way to the main control room and saving the starship.

The dictionary that comes with the program is limited to 200 words and this is only sufficient enough to allow commands of three or four words to be input.

Movement is dictated either by compass directions or by left, right, up, down, forwards and backwards.

Unlike many other adventure games, the player does not score any points for collecting objects and storing them away. Points are gained by progress. For example the user will get points for getting out of the freezer coffin and assembling the space suit. It is also possible to lose points if the player is killed or caught by one of the dreaded nightingales.

This is definitely one of those adventure games that will take weeks to solve and possibly months. It is so difficult that Level 9 Computing are supplying the consumer with a free clue.

Title: Snowball

Company: Level 9 Computing, 229 Hughenden Road, High Wycombe, Bucks HP13 5PG, telephone 0494

Type of game: Textual adventure

Text: Good

Hardware required: 64, cassette recorder, television

Description: Find your way to the main control room and save the

starship Price: £9.90 including VAT and post

and packaging CCI rating: ***



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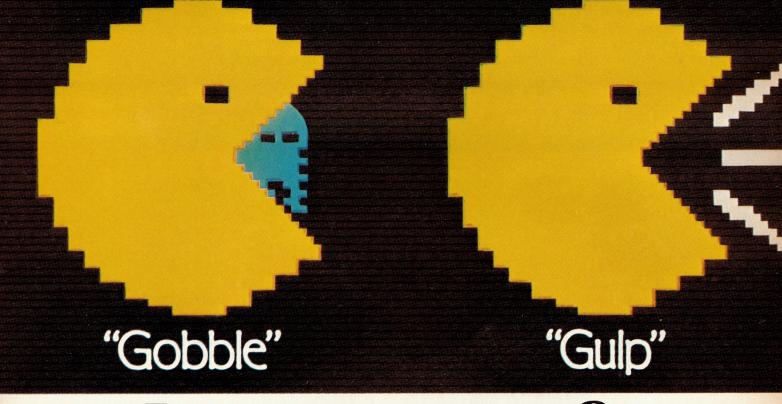
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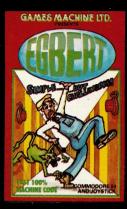
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George at once becomes the hero but he has many hazards to overcome including deadly arrows from the local warrior, deadly creatures and eggs carefully aimed from the air. Can George make it to the top of the mountain to take the spear and kill the bird? Will George finish the game before he drops his pipe and burns the house down?!

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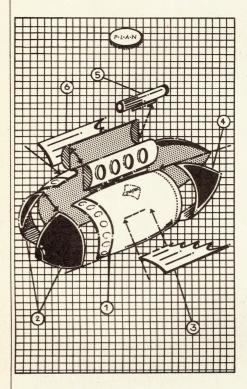
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Jetpac

Imagine being transported to the outer reaches of the galaxy, being the richest person in the universe and a chief test pilot for the Acme Interstellar Transport Company. If you can imagine you could probably play Jetpac well.

This is a new game for the VIC with 8K expansion. The aim is to asssemble a number of rockets on several planets, collect priceless treasures and destroy as many aliens as possible.

The ship is initially divided up into three sections, each section being located at different parts of the planet, which the player reaches using the latest Hydrovac Jetpac. Once the rocket has been assembled and refuelled all the player has to do is enter the spaceship and then ... liftoff! The player is transported to another planet where the task is exactly the same.

Control of the realistic looking astronaut is either via the keyboard or joystick, enabling the player to moonwalk and hover in mid-space. The graphics and sound effects are quite good considering the game is for the VIC and not the 64.

This is a one or two player game, with the number of lives left, high score and individual score being recorded at the top of the screen.

Title: Jetpak

Company: Ultimate Play The Game Address: Ashby Computers and Graphics Ltd., The Green, Ashby-De-La Zouch, Leicestershire LE6 5JO telephone 0530 411485

Type of game: Arcade Graphics: Fair

Hardware required: 8K VIC, television, cassette player, joystick (optional)

Description: Travel the stars, assemble spaceships and gather the

treasure Price: £5.50 CCI rating: * * *

Pedes and Mutants

The instructions to Pedes and Mutants are a little bit difficult to read but well worth preservering with. It is a new game for the unexpanded VIC from Romik and after reading the description provided on the cassette cover the game sounds like an ordinary 'shoot-the-aliens' creation.

This is exactly what it is but with some noticeable differences - and what differences they are! The game is split into two parts although there is no great difference between the two. The whole object of the game is to get as many points as possible although the action is so fast the player cannot tell exactly what is being hit or, for the first few games, what scores how much.

In the first part of the game the laser cannon is not stuck to the base of the screen but is positioned close to the top with the Pedes moving quickly towards it. To kill the Pede (which is worth 1000 points) it has to be shot about 10 times. There is so much happening and the action is so fast, the player has to keep moving and firing. Pedes are not the only aliens that have to be destroyed because fleas and ants make an appearance as well.

It is not until all the six Pedes have been destroyed that the player can progress onto the second screen. In this section of the game, the laser moves like an upside down pendulum and all the mutant invaders must be destroyed. Should one escape unharmed, the player will be back to square one on screen one.

Bonus points are awarded for destroying landing bases and motherships and an extra life is awarded at 10,000 points. The beginner to this type of game will be thankful for the choice of skill levels and for the fact that the action can be held.

The flashing multi-colour screen is a little aggravating to the eyes but on the whole the graphics are good with excellent explosive effects and some interesting use of sound effects.

Title: Pedes and Mutants Programmer: Pete Bradley Company: Romik Software, 272

Argyll Avenue, Slough, Berkshire Type of game: Arcade Graphics: Good

Hardware required: Unexpanded VIC. television or monitor, cassette player and a joystick (optional) Description: Get as many points as

possible by destroying the aliens Price: £6.99 including VAT

CCI rating: ***

Jackpot

Mr Chip, who designed the excellent game Westminster (see volume 2 number 7) have now brought out two versions of the fruit machine simulation game Jackpot. One is for the VIC and the other is for the 64 and both are written in machine code.

There are some minor differences between the two versions. With the VIC version the player gambles with pennies rather than pounds and the layout of the screen is slightly different. Obviously, the 64 has much greater graphic facilities and these are used to their full extent. The excellent graphics are not hi-res but user defined character graphics!

On the 64 it is possible to reach a maximum total of 250. To reach the maximum total on each game there are several features. Whenever the player wins there is the option to gamble, the maximum and minimum amount available being highlighted by flashing lights.

On the VIC version there are no numbers by the side of the fruit, the number of nudges being determined by the response of the player to the nudge panel at the bottom of the screen. On the 64 version, the number of nudges relates directly to the sum of the numbers to the right of the fruit. If this total is equal to seven the shuffle win comes into play. With this feature the reels spin a random win of 3 or 5.

When the number of nudges has been assessed, another handy feature is autonudge which is accessed by the function keys. Autonudge is only available on the 64 and means that the micro will automatically nudge the reels to the best available win with the available nudges.

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Dictator

In Dictator, the player is placed in charge of a small banana republic called Ritimban. Many dictatorial regimes are based upon large support from the armed forces and a questionable relationship with the populace. Dictator is no excep-

The aim of the game is to stay in power for as long as possible by retaining the favour of the army, secret police and landowners and siphoning off money from the State into a Swiss bank account.

Dictators will often get assassinated and this is only one of the difficulties that the player has to avoid. There is the threat of invasion from neighbouring countries and revolution by the peasants.

The popularity of the dictator is indicated by several circles that appear on the police report. This report is influenced by the actions of the dictator. Support from the peasants will increase but support from the landlords will decrease when the peasants are given free education.

The game takes on an international dimension with the entry of the Americans and the Russians - their financial support is quite important when the bottom falls out of the banana trade!

This game is based completely on text and has practically no graphics at all which is surprising because the game is for the 64. Surely some improvements can be made in that area? Despite this, Dictator is an interesting and enjoyable game.

Title: Dictator

Company: Dk'tronics, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AX. Telephone 0799 26350/22359

Type of game: Strategy Graphics: Poor

Text: Average

Hardware required: 64, television,

cassette recorder

Description: Stay in power for as

long as possible

Price: £5.95 plus 50p for post and

packaging CCI rating: ***

Megawarz

Travelling from Pluto to Earth is your mission in this game from Paramount Software. Between each planet, a group of aliens is waiting to ambush you and these have to be destroyed before you are allowed to continue to the next planet.

The aliens, instead of firing at you, simply have to touch you to ensure your annihilation and what's more are virtually indestructable. The only way you can progress on your mission is to wait for an alien to recharge its force field. Luckily you can see when this is happening as the alien, which is constantly changing colour, changes briefly white. It is in this brief period that you have the chance to destroy it.

This is the scenario in this very professionally put-together shoot-emup game. Your ship, joystick or keyboard controlled, is thus involved in a delicate cat and mouse game where you must keep close to the aliens to blast them, but far enough away for sudden changes of direction not to have you running into them.

Many other ships seem to have failed to get through as occasionally the body of an astronaut floats through the screen. These are well worth picking up for bonus points and to recharge your shield which allows an alien to pass through you without damage but at great expense to your energy reserves.

After each wave of aliens has been cleared, a bonus screen with several astronauts drifting about gives you a chance to refuel. On this screen, however, if you miss picking any astronauts up, they mutate in to particularly nasty aliens. Having survived this screen there is a delightful graphical trip to the next planet, which gives you time to catch your breath ready for the next onslaught. Of its kind a great game, and good value for money.

Name: Megawarz

Programmer: Jason Benham

Company: Paramount Software, 67 Bishopton Lane, Stockton, Cleveland.

Type: Arcade Graphics: Good Price: £7.50 CCI Rating: ****

Golf

Archdale Golf Club is an 18 hole par 72 course. You are asked to provide your handicap, and to admit to the worst feature of your game before beginning your round. Each hole is drawn randomly, and the distance to the hole and its par are given. At each stroke of the ball you have 13 clubs to choose from, each club will hit the ball a different distance.

All the expected hazards are presented, heavy rough, trees, bushes and the occasional stream are all to be

avoided. When you are on the green, a seperate display shows your ball in relation to the flag.

After getting around the 18 holes, vour score has to be entered, and an appropriate comment on your perform-

ance is given.

This game was a disappointment, the graphics were all standard Commodore keyboard characters, and the game looked as if it were on an unexpanded VIC rather than a 64. Your control over the ball's direction is minimal, you merely have the option to fade or draw (whatever that means). There is no animation of the main screen and the ball simply disappears when struck by an invisible golfer, and reappears somewhere else. The program seems to have been written in very basic Basic as the delay between taking a shot, and the screen reporting back that you are 'on the fairway' or whatever is not inconsiderable. The most skilful stage is on the green where you have to judge how hard to hit the ball, but a white blob jerking along a featureless black line to a stationary flag doesn't exactly make for a great evenings entertainment.

Name: Golf

Programmer: lan Green

Company: Anger productions, 14 The

Oval, Broxbourne EN10 6DQ Type: Arcade/Simulation

Graphics: Poor Price: £ 7.50 CCI Rating: *

Ludo

A competent and accurate program true to the original game in every way. There is a nice touch about the dice as they are shaken in a 'hand' rather than just being dots flickering in a box as they mostly seem to be.

From one to four players can take part although there is no option to play against the computer. Obviously a great deal of thought has gone into this program, unfortunately putting a boring game onto a new computer does not stop it from being a boring game.

This was a review sample only so maybe it will appear as one of a compendium of games for the 64, in which case there may be some purpose to it. Anyone for computer tiddleywinks?

Name: Ludo

Programmer: CP White

Company: C P White (Computers & Software), 52 Northfield Avenue, West

Ealing, London W139SY. **Graphics:** Average

CCI Rating: 3

A Living Legend

On January 13 Jack Tramiel resigned as president, chief executive and board member of Commodore. Tramiel has been the driving force behind Commodore for so long now that his resignation caused more than a few raised eyebrows. After all, to many in the business, Tramiel IS Commodore. Not any more. He will, we are told, continue as a consultant to the company. But nobody seems completely convinced that this is the end of the matter. Here we take a look at Tramiel, the man, and Tramiel the father of Commodore. How did he give birth to Commodore and what's it been like bringing up the child?

All the cliches you can possibly think of - small beginnings... little acorns apply to Jack Tramiel. He was the soldier at Fort Dix who repaired the US army's broken typewriters. After leaving the army he used his army experience and set up his own typewriter repair business in New York's Bronx.

The groundwork for Commodore was laid in the mid-1950's when Tramiel moved with his family to Toronto following the first of many successful business deals. It was around this time that Tramiel was developing the business skills which were to prove so useful later. The deal that took him to Toronto was a licence he negotiated with Czechoslovakia to assemble typewriters.

Although an entrepreneur himself Tramiel was a great believer in cutting out the middleman. It was this logic which led him to take over a typewriter manufacturing concern in Berlin. Why sell someone else's typewriters when you can sell your own?

Another of Tramiel's policies that led to his success is in keeping his ear to the ground. At this time he was quick to spot the growing trend for low-price mechanical adding machines flooding in from Japan and accordingly moved into the mechanical adding machine business.

In 1962, the company was of a sufficient size to go public, as Commod-



Jack Tramiel

ore Business Machines, Canada, with Tramiel as President of the company.

The longstanding team of Tramiel and Irving Gould came about after a scandal involving Tramiel's first Chairman, C Powell Morgan. Morgan was condemned by a Canadian Royal Commission Investigation in 1965 for 'his defiance of all accepted business principles' and for his acts of 'repacious and unprincipled manipulation.

Tramiel was not indicted by the Commission, although the scandal did make bank financing hard to come by. It was at this time that a Canadian investor. Irving Gould, agreed to buy a large stake in the company and to become its Chairman.

Under pressure from Japanese imports, Tramiel visited Japan to get first-hand experience of his company's opposition. Here he saw the new electronic desk-top calculator and foresaw the end of high volume sales of mechanical adding machines.

He switched Commodore computer's strategy and when the first electronic pocket calculator appeared it was Commodore who took it to market.

Direct competition between suppliers taught Tramiel not to rely on outside suppliers for key components. Gould came to his rescue again personally guaranteeing a \$3m loan, giving the company the buying power to purchase MOS Technology, then a struggling manufacturer of calculator and other semi-conductor chips. This was followed by the acquisition of Frontier, manufacturers of C-MOS chips, and MDSI, a liquid crystal display manufac-

The acquisition of MOS Technology gave Tramiel more than just experience in a key technology. It also gave him Chuck Peddle, the engineer who is reported to have told Tramiel to forget about hand held calculators and go for desk top computers. In line with one of Tramiel's favourite mottos 'Commodore is geared to giving consumers products they don't yet know they need, he instructed Peddle to build a desk top computer. And so the PET was born.

The PET met with an enthusiastic response and as demand grew, Tramiel again decided to leave out the middle man and went direct to big retail chain stores. After the PET, of course, came the Vic-20 and the Commodore 64, And, as they say, the rest is history.

Tramiel's decision to resign 'for personal reasons' coincides with a record trading year for Commodore, with the company becoming the first microcomputer company to report sales of over \$1bn in one year, more than doubling the previous year's sales. Speculation that Tramiel's decision to resign was not entirely of his own choosing has been denied by Commodore's Software Manager, Gail Wellington, who said: 'Tramiel is just tired. Last time I saw him he was having breakfast with Mr Smith (his successor) and I've never seen him looking so happy.

And an interesting thought to end with. This is not the first time Tramiel has resigned. In 1982 he resigned his position but took it up again in a very short period of time ...



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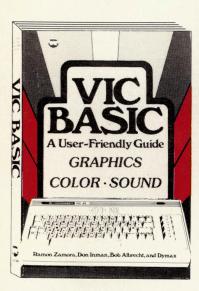
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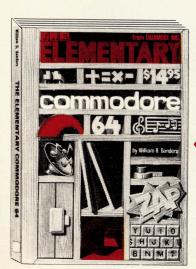
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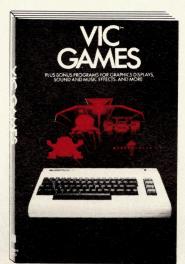
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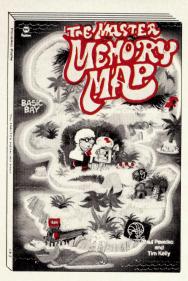
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SOFTWARE REVIEW

CBM's easy wordpro

EASY SCRIPT is Commodore's very own word processor for the CBM-64. John Probert tests the product for us.

EASY SCRIPT comes well packaged in a stout box containing a couple of programmed disks - one is a thoughtfully provided backup copy - and a handsome blue book of about a hundred pages. This is the User Guide, and it is without doubt one of Commodore's best efforts; avoiding both the almost total inscrutability of the manual supplied with the (1540) disk drive, and the dreadfully overwritten instructions that come with its VIC Stock Control - this latter takes about twelve pages to tell you that the Stock Control program is a system for controlling stock!

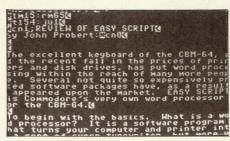
The disks would seem to be an expedient to get the processor on to the market early, for the intention, so I understand, was for it to be provided on a cartridge. This would be much more convenient, for then you could just plug in and go; but from a company that changes its mind about four times a week, I would not rely on its ever appearing. Certainly I have not been able to discover if it would be possible to trade in the disks against the cartridge, should it become available.

While loading the disk the screen shows the program title in a variety of colour combinations, and when loading is complete you are confronted with a disappointingly drab grey and white display.

You are first asked to choose the width of screen text. This would normally be (for the CBM-64) 40 columns, but up to 240 colums can be selected for exceptional text formats. You can next choose to store your text on disk or cassette, but since you have just loaded the program from disk it would seem odd to wish to file the results on to tape, with all its inconvenience.

Finally you can choose from a list of printers the one you wish to use. This gives the program tremendous versatility.

Having made your choices the screen changes to put you into what is called EDIT mode. And the first pleasure is to discover that you are not stuck with the depressing initial colour scheme. By using



A screen shot showing EASY SCRIPT in the Edit Mode.

the CTRL key and keys 1, 2 and 3 you can change the border, background and text colour to suit your own taste and mood.

The manipulation of text is accomplished by the use of format instructions. These can be sprinkled throughout the text at convenient intervals, but the normal proceedure will be to bunch the main ones together at the beginning. The instructions will be displayed upon the screen, but, of course, they are not recorded upon the completed document. Each one is obtained by first using the function key F3, which places a reverse field asterisk at the start of the line. This is then followed by the format instruction.

This instruction can be one of many. It can give the document a title of your choosing, which can later be used for filing purposes. It can be used to set the margins of the paper; to justify the right margin; to centre a heading; create page numbers; decide line spacings, etc, etc.

You can make the format instructions as simple as you like for straightforward documents, and only with time and experience do you need to involve yourself in the complexities of all the rich and varied instructions that are (quite literally) at your fingertips. This means that you can put the program to use - after learning a few of the commands - from the very first day.

The topmost line of the screen display, the one above the first format instruction, is called the STATUS line, and this is entered by pressing the F1 function key. If you are tapping in text this will normally display EDIT MODE, and will also record the position of the flashing cursor in terms of lines and columns. A change of function - or MODE, as it is called - to, say, COMMAND mode to output to the printer is accomplished by pressing F1; entering O for output, followed by P for printer.

Formatted text can also be displayed upon the screen, prior to printing, and if the print format is wider than the screen (which with a 40 column screen it almost always is) you can view the entire document by scrolling back and forth and down-but with EASY SCRIPT not up!

The command mode can also be used to erase text, delete text, (ves, there is a difference), file your document, load another document, etc. But for now, back to the EDIT mode and the entering of the text itself.

Using EASY SCRIPT the CBM-64 keyboard functions for the most part just like a normal typewriter keyboard, so a trained touch-typist, having first got used to the "feel" of the keys, should have no difficulty using it. The unshifted text is displayed in lower case letters: capitals and punctuation marks are obtained in the usual way by using the shift key.

The shift lock works just like the one on a typewriter, but as an added convenience the F5 key gives you capital letters without altering the function of the other keys on the board. This is a most useful asset. The major difference from typing on a typewriter is in using the RETURN key. You do not press this at the end of a line. You just carry on typing regardless, and the cursor automatically moves to the beginning of the next screen line.

Since this is done in the middle of a word if needs be, the result can look a little odd at first, but you soon get used to it. The true line ends are decided (in accordance with the format instructions) when the text is output to the printer or screen. The RETURN key is only used at the end of a paragraph or to mark a blank

The common alterations to text such as corrections to spelling, removal of typing errors, the adding, deleting or changing of odd words, are all easily accomplished by the use of the normal cursor controls together with the INSERT and DELETE keys. Words and phrases can be simply typed over on the screen, taking care not to use the RETURN key as when programming, for this would wipe out the remainder of the line!

This easy method of correcting is a great boon to an enthusiastic, but inaccurate typist like myself, for I can bash away at the keys as inspiration moves me, ignoring the mistakes as they happen,

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The Electronic Cash Book



SOFTWARE REVIEWS

then returning later to tidy up the whole thing. I find the constant need to resort to the correcting ribbon on my electric typewriter an inhibiting and daunting distraction.

More major alterations of text such as the removal and replacement of whole sentences or even the swapping over of complete paragraphs are best performed by using format instructions, all of which are fully detailed in the excellent manual.

There are far too many facilities to detail here, but perhaps I should mention one or two. One is called MAIL MERGE. and this allows you to send a "personalised" letter to a group of people, drawing upon what is called a FILL FILE to provide names and addresses. Myself, I dislike to receive such "personalised" letters, and consign them, unread, into the wastepaper basket; but still, I can see that is a facility that a lot of people would want from a word processor. Forms can be filled in using the TAB function (both horizontal and vertical), or what are called MEASURED BLOCKS.

Your completed (or uncompleted, for that matter) text can be easily saved as a file on to disk. It can also, as we have said, be saved on to cassette. A few disks could accommodate a large amount of material and perhaps replace those dreary filing cabinets. One step nearer to the so-called paperless office. Though, ironically enough, since I computerised a lot of my own activities I seem to be using vastly greater quantities of paper than ever before.

The final presentation of your text depends, of course, upon the quality of your printer. My dot-matrix 1515 printer, though a good work horse, leaves something to be desired when it comes to correspondence. The lack of descenders, for instance give the print a decidedly odd appearance, and, I hear, causes distress to overworked and underpaid print compositors. (no boys, please don't send the pickets round, it was just my little joke!).

Since paper may only be tractor fed you are stuck with using the usual perforated stuff, which is hardly going to create much of an impression among the punters who are going to invest money in your business. But, encouragingly, a few daisy wheel printers are starting to emerge that, while hardly discount house material, are just a little less than the cost of a motor car. Illustrated is an example of the print obtained from the new JUKI daisy wheel printer priced at well under £500. (Courtesy of Taylor Wilson Systems of Dorridge).

EASY SCRIPT contrives to work the 1515 printer without the usual annoying and irritating need to blank out the screen, though the printer does hang up occasionally; a hiatus that can only seem to be overcome by switching the printer off and on again. But this is presumably the design fault in the 64 (and one that has been strangely uncommented upon by the pundits in the magazines) and not a defect in EASY SCRIPT. One disappointment, however, is the inability of EASY SCRIPT to allow you to use any of the graphic symbols obtainable on the CBM-64 and the 1515.

To sum up. Do I like EASY SCRIPT? Yes I do, very much. Do I use it? Yes I do, all the time. I typed and corrected this article using it, and the memory of the 64 will retain it all without the need to resort to split files. One last facility to mention. Like the manual writer, throughout the review every time I wanted to type in the words EASY SCRIPT I typed in ES instead; then finally I used the SEARCH AND REPLACE command to substitute EASY SCRIPT for the abbreviation.

Any complaints? Well, for myself, only two. The inability to use the 64's graphics, which could be really useful for laving out some documents: and the price. I was relieved of £85 for my EASY SCRIPT, though I understand the going price is now £75. This is still far too much to pay for a couple of disks and a book.

I realise that development charges are heavy, but with the greater volume of sales that this program undoubtably deserves to achieve, perhaps Commodore will pursue its avowed policy of pricing to suit the pocket of a mass market.

P.S. Since writing the above paragraph. I have read that Commodore have announced one of their special offers. The price of the disk drive has been again reduced from £230 to £199, and they are throwing in EASY SCRIPT free! What can I say? Some people charge that for the word processing software alone. Go out and buy one, while, as they say, stocks

Word games

In spite of its name Wordpower is not just another wordprocessor. Produced by Sulis Software and distributed by John Wiley, Wordpower is an educational vocabulary and spelling package for

One of the main aims of CAL is to make learning fun. To this end Wordpower contains two games with different levels of difficulty. It is a menu driven program which makes it relatively easy to use but does presume that the user will be familiar with the words displayed on the menu

Some of them are tough words and might challenge your average Sun reader! Menu options include, for instance, Opposites, Similies, Collectives, Synonyms, Adjectives and Nouns.

In each section of the program there is a choice between a 'game' or a 'writing' option. The game option is itself further subdivided into two choices -Lines or Shooting. Lines is a multiple choice game in which the user would be asked to match one word with another in a list of words. Britain, for instance would match with British. The Shooting game involves destroying the incorrect word by using the space bar to shoot it.

Throughout the program the screen displays are very simple. There's none of the spectacle of the arcade game though

there is an obvious attempt to emulate them. Children, or even adults with reading difficulties, may find the game reasonably entertaining.

But the vocabulary is limited to 1,200 words and we must question the idea that it's enough to provide learners with a simple game. Kids these days are used to playing the most sophisticated arcade games and Wordpower won't fool them for one minute. One can imagine a child resenting the attempt to trick him into

Having said that, Sulis Software have made a very honourable attempt to make learning about language as enjoyable as possible. The vast majority of CAL software works along similar lines and within that context Sulis Software's Wordpower is good.

Name: Wordpower Company: Sulis Software, 4 Church Street, Abbey Green,

Bath, Avon

Product: Educational game Applications: Education Documentation: Poor leaflet. Most instructions are on the

cassette

Minimum hardware: 64, monitor and cassette player Price: £9.95 plus VAT

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HARDWARE REVIEWS

Stack aim high

Stack Computer Services have adapted the principle of light pens and developed a Light Rifle for use with CBM 64 and Vic 20. The rifle is made of plastic and comes in a kit form. Included in the package are the necessary interfacing gadgets and a game cassette.

The television screen must be so positioned that little or no extraneous light falls on the screen. This is due to the sensitivity of the light receptor in the rifle. The rifle reacts to the light coming from the television screen and can actually distinguish differences in the colours – white and red being the most visible and blues least, so the user must create a good colour balance prior to playing any games.

Depending on the quality of picture the user will normally be able to play fast and accurate games from 8 to 12 feet away from the television set.

The actual assembly of the rifle is a

simple matter. The butt clips onto the pistol unit, which houses the touch contact and light sensitivity device, just behind the hand grip. The rifle barrel slips into and locks onto the pistol barrel for easy conversion. Without the butt the rifle becomes a hand gun.

The games supplied on the cassette are: High Noon Shootout, the aim of which is to protect your land from being blown up by a gang of bandits; The Glorious Twelfth, the man in the street's opportunity to go grouse hunting. And finally, Gallery, where the user has to have fast reactions to shoot down a target as it bounces around in an open box.

The games are reasonable but not sensational and one suspects that there is potential for much better games. Our rifle worked well and, once you get used to its little idiosyncracies – the sights weren't lined up quite correctly – it is

surprisingly accurate.

All in all the package is a useful and enjoyable addition to the enthusiasts collection of games paraphenalia.

Name: Stack Light Rifle. Company: Stack Computer Services, Derby Road, Bootle, Liverpool. Tel: 051 933 5511.

Product: Light Rifle.
Applications: Games.
Documentation: Adequate

leaflets.

Minimum hardware: Vic 20 or CBM 64, cassette recorder, television set.

Special Features: Kit includes a cassette containing three games which will run on both the Vic 20 and CBM 64.

Price: £29.95 including VAT.

Micro's talk back

Adman's package looks very much like an expansion cartridge and fits into the expansion port at the back of the VIC. Voice synthesisers such as Adman's package work by breaking language down into its basic sounds. One of the problems is that there are far too many of these basic sounds, or allophones, to be stored in the memory of a home computer, even with a memory as big as the Commodore 64.

The Adman Speech Synthesiser uses 64 allophones altogether and combinations of these allophones produce the words. Not all allophones can be used with all others, of course. Many combinations of consonants, for instance, would be impossible in many languages. And more than three vowels together is unlikely in English.

Each key produces a sound and the sounds are strung together to produce a word when function key F3 is pressed.

Lack of space in each operating block

means that only 30 allophones can be coped with at a time. Bundles of 30 allophones or less are therefore stored using string formats. It is possible to disable the voiceback by using the RUN/STOP and RESTORE keys or by keying in SYS41009, which stops the repetition of individual keys. There are pauses of several lengths, lasting from 10 milliseconds to 200 milliseconds, which prevent words running into each other.

Allophones don't unfortunately always correspond exactly to spellings. Split into Adman allophones, for instance, the word 'answer' becomes A/N/S/ERR. This would limit the package's educational value to some extent.

So what uses might Adman's Speech Synthesiser have? It might be useful for amateur games programmers and it can certainly be a great deal of fun. Like all other speech synthesisers we have seen (or should we say heard?) it has its limitations. This is obviously a field where a great research might produce some impressive results. There are universities where exciting work is being carried out in co-operative ventures between computer departments and linguistics departments.

Meanwhile packages such as Adman's provide a useful entertainment and, for some, a useful tool.

Title: Speech Synthesiser

Company: Adman Electronics, Ripon Way, Ripon Road, Harrogate, North Yorkshire HG1 2AU. Telephone (0423) 62642

Product: Voice Synthesiser

Applications: Education and games programming

Documentation: Adequate manual with sample programs

Hardware: Unexpanded VIC (and now.

we understand the 64) with TV

Price: £49.95 including VAT

INTERFACING

Double trouble with a

Owen Murcott's practical feature about linking any two Commodore machines through their user ports continues with a two-machine game this month. If you missed the earlier articles in the series, you should write to Commodore Computing International for the back issues you need. You will then be able to start from the beginning with simple DIY instructions on how to make the connector, and how to control the user port from BASIC. You don't always have to write assembler programs to get two machines to communicate.

Looking back over this series, I see that i have only given you skeleton programs to demonstrate the principles of machine-to-machine communication through the user port. Although perhaps instructive, they are a bit boring and not of immediate use. This month I thought I would liven things up a bit by giving you a game. It is not original, but is based on one of the first games which ever appeared for the PET, named 'Wrap Trap'. I bought a copy in 1978 with my first machine. Quite simply, you and the machine try to wrap a wall around each other, causing the other to crash. In my opinion, Wrap Trap still meets all of the criteria for a good game!

Double Wrap Trap

The original version of Wrap Trap on the PET ran as 'player vs machine'. I have modified it to give you a two-machine version: player vs player. It uses the VARLINK routine from last month's article to pass variables from one machine to the other; your machine displays your opponent's moves on your screen. So you must load VARLINK first, and reset the memory limit to protect it. before you load the game.

Line 410 includes a relatively uncommon feature - the program prints an 'INSERT' character. Its function is to push the final dot into place on the screen for the matrix guide. You cannot enter an. INSERT character into a program by merely pressing that key. Try it, and you will see that it just opens a gap, as usual. To obtain this character in BASIC text:

- * Type the line as listed, but with a space in place of the INSERT character;
- * Press RETURN;
- * Move the cursor back up to that space character, press RVS ON, type a shifted

't' character:

* Press RETURN.

The reversed shifted 't', which is BASIC's encrypted 'INSERT', will remain in the

The listing includes alternative lines for different machines - leave out those which are not for your machine. You will see that I have suggested that you use number keys on PET, and function keys on VIC and CBM64, to control the wall-maker. The VIC function keys will not do this if you have a 'Super Expander' cartridge plugged in to expand the memory; you can only use a 3K RAM cartridge. Also you will need to adjust the layout of instructions to get a tidy appearance on the VIC screen. Use the alternative version of VARLINK (explained further on) which loads to location 7168, if you run the game on an unexpanded VIC, so that you will not run out of memory.

Wait

Look at lines 520/720 and 620/820 of DOUBLE WRAP TRAP. You will see that at one moment the machine is the master, at another it is the slave. The slave waits for the master and cannot go on until the master has communicated. Notice that the slave does not impose itself on the master: the master invites communication when it is free. From the slave's point of view, it has to wait until the master signals that it wants to talk, or that it is ready to listen.

Interrupting

Sometimes, either machine must be able to impose itself on the other, interrupt it, and demand attention. Neither is master nor slave; they are equal partners. This kind of system can

best be implemented using the mechanism built in to the hardware of the microprocessor which permits it to be interrupted. The 6500 series of microprocessors used by Commodore will react to three different kinds of interrupt, created and controlled in different ways. Two of them affect data transfers on the user port, in addition to their other functions. The main one is known as IRQ (Interrupt ReQuest).

IRQ-What is it?

IRQ interrupts are constantly being created within the machine, by the clock for example, 60 times per second, or so. the clock signals the microprocessor to interrupt your program. The operating system then does various pieces of housekeeping. One of them tests whether you are pressing a key on the keyboard. If you are, the code for the key pressed is placed in the input buffer. BASIC programs are constantly being interrupted - it all happens so fast that you never notice.

When an interrupt occurs the microprocessor will:

- Stop at the end of execution of the operation currently being obeyed in your assembler program (or in the interpreter if your program is in BASIC);
- * Make a note of where it had got to;
- * Stop any further interrupts happening until it has . . .
- * Got the address of an alternative set of instructions (the interrupt routine) and executed them to their end.

The interrupt routine is built in to ROM. At the end of it is an RTI (ReTurn from Interrupt) instruction, Its effect is to send the microprocessor back to where it originally left off in the main program,

TERFACI

wo-machine game

which continues as though nothing had happened.

Interrupts spoil timing

There is a timing problem in assembler programs when the master machine wants to send (or get) bytes on the data link. It has to wait until the slave is listening and ready to communicate. The handshaking during this waiting period has to be very carefully timed; last month's timing diagram explained the problem. But interrupts will spoil it. Execution of the built-in interrupt routine takes an appreciable amount of time this causes delay. If an interrupt happens at the wrong moment, the machines get out of step, and may hang up.

Don't interrupt until I've finished!

You can prevent the microprocessor from recognising an IRQ interrupt, and thereby you can eliminate the delays. The instruction to use in an assembler program is SEI. This sets the interrupt flag in the status register. (The microprocessor will also set it quite automatically when an IRQ interrupt occurs.) The normal purpose of this flag is to prevent any further interruption until the IRQ routine has been executed. Otherwise it might just go round in ever-decreasing circles! So, by setting the flag, you will disable the IRQ interrupts, and by clearing it with CLI you will re-enable them.

NMI and the Commodore 64

There is a second kind of interrupt which cannot be disabled by an SEI instruction. It is called NMI (Non-Maskable Interrupt). It has a higher priority than IRQ. Even though an IRQ interrupt may occur at the same time, NMI will take precedence. Unfortunately, the user port interface chip on the Commodore 64 can cause NMI interrupts, and SEI doesn't stop them.

Later in this article, I explain how to enable the user port to cause interrupts. On the Commodore 64, NMI interrupts from the user port chip can sometimes be enabled by routines in the operating system in ROM. You must disable them at each entry point, to ensure that they do not happen during your assembler program and introduce delays into the handshaking. The procedures for disabling are similar to those for enabling, explained later.

10 rem double wrap trap	w.owen murcott december 1983
11 rem	2,0,-1,30:rem pet
21 data 144,240,31488,160,102,46,40,39,	24,32768: rem pet
22 data 0,2,48,50,56: rem 23 poke 59468,14: rem	pet pet
24 rem	
30 data 5,4,16,18,0,-1,30,-1,0,60,1,0,6 31 data 788,121,7168,160,160,46,22,21,2	
32 data 0,1,132,30720,2,6,133,136: rem	vic
33 poke 36879,8: print chr\$(14)"{YELLO	D": rem vic
40 data 10,7,29,17,0,-1,30,-1,0,60,1,0,	62,0,1,22: rem cbm64
41 data 788,240,39936,160,160,46,40,39, 42 data 0,1,132,55296,2,6,133,136: rem	
43 poke 53280,11: poke53281,11: print c	hr\$(14)"CYELLOWD": rem cbm64
70 print "CCLS)Did you start this machi	no first (u/n)?
80 gosub 9000:if a\$<>"y" and a\$<>"n" th	en 80
90 ifa\$="y" thenfg=1:z\$="upper":u\$="YOL 91 fg=2:z\$="lower":u\$="HE":c\$="YOU"	":c\$="HE":goto 100
99 rem	
100 print "CCLS" (RVS) W R A P A R 120 print "CD3The object of the game is	OUND TRAP"
121 print "opponent. Your wall-maker s	
122 print z\$ " part of the screen. 123 print "Control it with the keys 2	4 6 8 ": print: rem pet
124 print "8 - up 4 - left": rem 125 print "2 - down 6 - right": rem	pet pet
125 print "2 - down 6 - right": rem 126 print "Control it with the function	pet keys": rem vic & cbm64
127 print "f1 - up f3 - left": rem	vic & cbm64
128 print "f7 - down f5 - right": rem 130 print"(D)"u\$" will set the speed an	vic & cbm64
131 print"CDDF=Fast M=Medium S=Slow	
134 print"CD3At the game end the winner	
135 if fg=1 then fori=1to3000:next 199 rem	
200 for i=1 to 4: read z: next	
210 dim x(4),y(4),c(4) 211 for i=1 to 4:read x(i),y(i),c(i): r	ext
220 read in	
230 read z: for i=1 to z: p\$=p\$+".": ne 240 read v1: v2=v1+7	xt
241 if fg=2 then z=ul: ul=cl: cl=z:rem	pet
250 read ul,cl,p 260 read f,mx,my,s,z,l,n	
270 read sc,uc,cc: rem 280 read kl,kh	vic & cbm64
290 poke ir,peek(ir)+3: if fg=2 then 35	
299 rem	
310 gosub 9000	
311 if a\$="f" then tl=0:goto 320 312 if a\$="m" then tl=70:goto 320	
313 if a\$="s" then tl=150:goto 320	
314 if a\$<>"q" then 310 315 tl=-1	
320 sys v2,t1:goto 400	
350 print"(DD:CRVSDOpponent sets speed 360 sys v1	
399 rem	
400 if tl=-1 then poke ir,peek(ir)-3: p 410 print "CCLSD";p\$;p\$;p\$;p\$;left\$(p\$,	
420 ud=3: cd=2: c=0	The CES CENTS of the Cest of t
430 restore: read ux,uy,cx,cy	
440 ua=s+ux+f*uy: ca=s+cx+f*cy 450 get a\$:if a\$<>"" then 450	
460 if fg=2 then 720 499 rem	
500 get a\$:if a\$ <chr\$(kl) a\$="" or="">chr\$(kh</chr\$(kl)>) then 520
510 d=(asc(a\$)-n)/l:if int(d)=d then ud	
520 sys v2,ud 530 gosub 9070	
540 gosub 9040	
620 sys v1 630 gosub 9080	
650 on c+1 goto 500,1000,1100,1200	
699 rem	
730 gosub 9070) N
800 get a\$:if a\$ <chr\$(kl) a\$="" or="">chr\$(kh 810 d=(asc(a\$)-n)/l:if-int(d)=d then cd</chr\$(kl)>	
820 sys v2,ed	
830 gosub 9080 840 gosub 9040	
850 on c+1 goto 720,1000,1100,1200	
899 rem	

TERFACI

A mistake

The intent of this series of articles is to share my discoveries and the results of practical experiment. But because it is about experiments, it is also about mistakes.

In last month's versions of MEMLINK and VARLINK the interrupts are disabled while the master is awaiting the slave. Then they are re-instated so that the STOP key can be detected during execution of those machine code routines. This permits you to use the key to quit the machine code if necessary. When writing the Double Wrap Trap game for this month's article, I found that it would generally work, but would occasionally hang up. I could press STOP and abort the program, but then I couldn't continue. Eventually I traced the problem to the occurrence of an interrupt during the transfer of the bytes. of a variable. It caused the handshaking to get out of step.

MEMLINK and VARLINK

Both MEMLINK and VARLINK are affected by the interrupt timing problem, but not my earlier PROGLINK routine. This month, I have given you a revised version of these two routines which will not hang up. There was no point in wasting space by giving the loader again, so I have omitted it and have just given the DATA statements. You can use the same loader as before.

There are two revised versions of VARLINK for the VIC. One will sit alongside MEMLINK, as in the previous version. The alternative version loads to the same locations as MEMLINK. (The first number in each group of statements is the start address of the routine; the second is a sumcheck.) I have provided the alternative version to use with 'Double Wrap Trap' on an unexpanded VIC.

Precautions

My conclusion, after fixing my mistake, is that it is a wise precaution in assembler programs to disable the interrupts for the whole duration of a data transfer on the user port. You need to:

- * Disable IRQ interrupts with SEI;
- Stop the chip from causing further interrupts by storing the appropriate value in the Interrupt Enable Register (defined later).

Using SEI has the unfortunate side-effect of making the machine slightly less responsive to the keyboard. You may have to hold keys down for a moment,

```
1000 cs=cs+1:print"(CLS)(RVS) "u$;:gosub 9090:on fg goto 350,300
1100 us=us+1:print"(CLS)(RVS) "c$;:gosub 9090:on fg goto 300,350
1200 us=us+2:cs=cs+2
1201 poke a,214
1202 print"(CLS>(RVS) B O T H";:gosub 9090:on fg goto 300,350
9000 get a$:if a$<>"" then 9000 9001 get a$:if a$="" then 9001
9002 return
9009 rem--
9030 x=x+x(d):y=y+y(d)
9031 if x < z then x = mx
9032 if x > mx then x = z
9033 if y<z then y=my
9034 if y>my then y=z
9035 a=s+x+f*y
9036 return
9039 rem--
9040 if tl then for i=1 to tl:next
9041 return
9049 rem----
9070 x=ux:y=uy:d=ud:gosub 9030
9071 if peek(a)<>p then c=c+1
9072 poke ua,ul
9073 poke ua+sc,uc: rem
9074 poke a,c(ud)
                                                                                 vic & cbm64
9075 poke a+sc,uc: rem
9076 ua=a:ux=x:uy=y
                                                                                 vic & cbm64
9077 return
9081 if peek(a)<>p then c=c+2
9082 poke ca,cl
9083 poke ca+sc,cc: rem
                                                                                 vic & cbm64
9084 poke a,c(cd)
9085 poke a+sc,cc: rem
                                                                                 vic & cbm64
9086 ca=a:cx=x:cy=y
9087 return
9089 rem-
9090 print" CRASHED!"
9091 print"
                               (LLLLLLLLLLL)"u$"="us;c$"="cs
9092 return
9099 rem----
```

```
READY.
1010
     SPECIMEN ASSEMBLER SOURCE CODE
                                  - PET BASIC4
1030
     ; DEMONSTRATES RE-DIRECTION OF IRQ
1.040
1050
     1060
1070
                          PAGE ZERO LOCATIONS
1080 CINV
           =$90
                         ; RAM IRQ POINTER
1090
                          ROM LOCATIONS
1100
1110 TROEND =$FADD
                         :IRQ ENDING ROUTINE
1120
1130
                          CHIP REGISTERS
1140 IC
           =$E84D
                         ;INTERRUPT FLAG
;INTERRUPT ENABLE
1150 IE
           =$E84E
1160
1170
                         PROGRAM CONSTANTS
1180 INTDIS =2
                         ;TO DISABLE INTERRUPTS
1190 INTEN =130
                         ;TO ENABLE INTERRUPTS
                          ALSO TO TEST INTERRUPT FLAG
1.22.0
                         ENTRY POINT TO RE-DIRECT RAM IRQ POINTERS ;LO IRQ POINTER PRESENT VALUE
           LDA CINV
1230 ENAEL
           STA IRQST
LDA CINV+1
1240
                         SAVE IT IN RESERVED BYTES
1250
1260
           STA IRQST+1
1270
           SEI
                         ;DISABLE INTERRUPTS
;LO START OF OWN CODE
1280
           LDA #<OWNCDE
1290
           STA CINV
                         RESET RAM POINTER
1300
           LDA #>OWNCDE
1310
           STA CINV+1
1320
           LDA #TNTFN
           STA IE
1330
                         :TO ENABLE CHIP TO INTERRUPT
1340
           CLI
                         RE-ENABLE INTERRUPTS
1350
           RTS
                         :AND RETURN
1370
                         ENTRY POINT TO RESTORE RAM IRQ POINTERS
1380 DISABL SEI
                         :DISABLE INTERRUPTS
1390
           LDA #INTDIS
1400
           STA TE
                        ;TO STOP CHIP FROM INTERRUPTING
;SAVED LO IRQ POINTER VALUE
1410
           LDA IRQST
           STA CTNU
                         RESTORE RAM POINTER
          LDA IRQST+1
                         ;HI
1440
          STA CINV+1
```

NTERFACING

rather than just touching them. Also, the STOP key won't work. If a 'STOP' feature is necessary in your assembler program, it must test the key periodically itself. You cannot depend on the keyboard scan included within the interrupt routine in ROM, because it will never be entered. Instead, you must use the entry points which that routine uses. Your assembler program should perform the following subroutine calls (true for PET, VIC and 64):

- * JSR \$FFEA Updates TI clock and gets keypress
- * JSR \$FFE1 Tests STOP key pressed and, if so, sets the Z flag. BEQ to your STOP exit.

The User Port can interrupt

It is possible to enable the user port interface chip to create an interrupt when the chip receives a handshake signal. By doing this, you can remove the need for your program to await the signal. Instead, the program will get on with something else, and will only be interrupted when a handshake is received, signifying that the other machine wishes to communicate. At this point, further interrupts will be disabled by the microprocessor, your own interrupt routine will be entered, and this will handle the data transfer imposed by the other machine.

One example of how you could use the ability to interrupt is to permit two machines to share a disk drive. One machine is connected directly to it. The other accesses the disks through the first machine, and communicates via the user port. When the extension machine requires to write to a disk, it interrupts and transfers its data to the main machine. Your interrupt routine in this machine then writes to the disk. The main program is temporarily halted while this happens, and as soon as the transfer is finished it continues from where it left off.

Enable and disable

To enable the chip to interrupt the microprocessor when a handshake is received, you have to set certain bits in the Interrupt Enable Register (IE for short). By clearing them, you will disable this ability. Here are the addresses and values to store:

	IE	Value to	Value to
	address	enable	disable
* PET	59470	130	2
* VIC	37150	140	16
* 64	56589	140	16

```
1.450
          CLI
                       ; RE-ENABLE INTERRUPTS
                       ; AND RETURN
1460
         RTS
1.470
         KXXXX
1480
                        ENTRY POINT WHEN AN INTERRUPT OCCURS
1490 OWNCDE LDA IC
                       ;INTERRUPT CONTROL
;TO SAVE IT (ONLY NEEDED FOR CBM64)
1500
          TAX
1510
          AND #INTEN
                       ; IRQ AND HANDSHAKE FLAGS
1520
         CMP #INTEN
1530
         BEQ OWNIRG
                       ;THEY ARE BOTH SET
1540
          JMP
             (IRQST)
                       GO ON TO NORMAL IRQ ENTRY
1550
1560 OWNIRG
                        THIS IS WHERE YOUR OWN CODING SITS
1570
1580
          JMP IRGEND
                       ; TO TIDY UP AT THE END
                       *****************
1590 :*****************
                        RESERVED BYTES
1600
1610 IRQST
          .BYT 0,0
                       FOR SAVING PRESENT RAM IRQ POINTER VALUE
END
```

```
59998 REM MEMLINK
                                                                                                                                                          W. OWEN MURCOTT
                                                                                                                                                                                                                                                                      REV.DEC 1983
 59999 REM-
60000 DATA 32000, 41037; REM
60010 DATAA 9,00,85,00,4C,38,7D,A9,4D,D0,02,A9,CD,85,00,20,27,7E,A5,12,48,A5,11
60020 DATA 49,20,85,10,4C,38,7D,A9,4D,D0,02,A9,CD,85,00,20,27,7E,A5,12,48,A5,11
60020 DATA 40,28,27,7E,A5,12,48,A5,11,48,20,27,7E,A5,11,85,4F,A5,12,85,50,68,85
60030 DATA 4D,68,85,4E,68,85,4E,68,85,4E,68,85,4C,A9,00,8D,4B,EB,AD,4C,E8,29,FE,8D,4C,E8
60040 DATA AD,4C,E8,09,E0,8D,4C,E8,A9,02,8D,4E,E8,78,AD,41,E8,AD,4C,E8,09,E0,8D
60050 DATA 4C,E8,A5,10,D0,1B,8D,43,E8,20,0B,7E,A0,07,88,D0,FD,AD,4D,E8,29,02,F0
60060 DATA 4C,E8,A5,10,D0,1B,B9,43,E8,20,0B,7E,A0,07,88,D0,FD,AD,4D,E8,29,02,F0
60070 DATA 02,F0,F0,D0,00,AD,4C,E8,29,DF,8D,4C,E8,AE,41,E8,10,E0,8B,D,4C,E8,A9,FF
60080 DATA 8D,43,E8,A2,00,A0,16,D0,18,20,0B,7E,20,1C,7E,95,4B,E8,88,D0,F4,20,19
60090 DATA 7E,C9,40,D0,22,F0,39,20,1C,7E,85,4B,8D,41,E8,20,0B,7E,E8,88,D0,F1,20
60110 DATA 1C,7E,A5,00,48,8D,41,E8,20,0B,7E,68,C9,4D,D0,19,A9,FF,8D,3,E8,A0,00
60110 DATA 20,1C,7E,51,4E,8D,41,E8,20,0B,7E,20,44,7E,90,F0,58,60,A9,00,8D,43,E8
60120 DATA 60,00,20,19,7E,91,4F,20,3E,7E,70,F6,58,60,AD,4C,E8,29,DF,8D,4C,E8,09
60130 DATA 60,8D,4C,E8,60,20,8B,7E,AD,4D,E8,29,02,F0,F9,AD,41,E8,60,20,FB,CD,20
60140 DATA 9F,CC,A5,07,D0,08,A5,08,D0,03,20,D2,D6,60,AZ,A3,4C,57,C3,E6,4F,D0,02
  60000 DATA 32000, 41037: REM
 60140 DATA 9F,CC,A5,07,D0,08,A5,08,D0,03,20,D2,D6,60,A2,A3,4C,57,C3,E6,4F,D0,02
60150 DATA E6,50,A5,4C,C5,4E,90,08,D0,0C,A5,4B,C5,4D,B0,06,E6,4B,D0,02,E6,4C,60
  60160 DATA
 60200 DATA 32000, 40923: REM
 60210 DATA A9,00,85,00,4C,38,7D,A9,4D,D0,02,A9,CD,85,00,20,27,7E,A5,12,48,A5,11
60220 DATA 48,20,27,7E,A5,12,48,A5,11,48,20,27,7E,A5,11,85,4F,A5,12,85,50,66,85
60230 DATA 4D,68,85,4E,68,85,4E,68,85,4C,A9,00,8D,4E,E8,AD,4C,E8,29,FE,8D,4C,E8
60240 DATA AD,4C,E8,09,E0,8D,4C,E8,A9,02,8D,4E,E8,78,AD,41,E8,AD,4C,E8,09,E0,8D
60330 DATA E0,8D,4C,E8,60,20,0B,7E,AD,4D,E8,29,02,F0,F9,AD,41,E8,60,20,F5,BE,20 60340 DATA 98,BD,A5,07,D0,08,A5,08,D0,03,20,2D,C9,60,A2,A3,4C,CF,B3,E6,4F,D0,02
  60350 DATA E6,50,A5,4C,C5,4E,90,08,D0,0C,A5,4B,C5,4D,B0,06,E6,4B,D0,02,E6,4C,60
  60360 DATA *
 60410 DATA A9,00,85,00,4C,38,1C,A9,4D,D0,02,A9,CD,85,00,20,27,1D,A5,15,48,A5,14 60420 DATA 48,20,27,1D,A5,15,48,A5,14,48,20,27,1D,A5,14,85,52,A5,15,85,53,68,85 60430 DATA 50,68,85,51,68,85,4E,68,85,4F,A9,00,8D,1B,91,AD,1C,91,29,EF,8D,1C,91
60440 DATA AD,1C,91,09,E0,8D,1C,91,A9,10,8D,1E,91,78,AD,10,91,AD,1C,91,97,97,E7,8D,1C,91
60450 DATA 1C,91,45,00,D0,1B,8D,12,91,20,0B,1D,A0,07,88,D0,FD,AD,1D,91,29,10,F0
60460 DATA F1,AD,10,91,A2,00,A0,06,D0,30,AD,1D,91,29,10,F0,02,D0,09,AD,1D,91,29
60470 DATA 10,F0,F0,D0,00,AD,1C,91,79,P7,8D,1C,91,AE,10,91,09,E0,8D,1C,91,A9,FF
60480 DATA 8D,12,91,A2,00,A0,06,D0,18,20,0B,1D,20,1C,1D,95,4E,E8,88,D0,F4,20,19
 60490 DATA 1D,C9,4D,D0,22,F0,39,20,1C,1D,B5,4E,BD,10,91,20,0B,1D,E8,88,D0,F1,20 60500 DATA 1C,1D,A5,00,48,8D,10,91,20,0B,1D,68,C9,4D,D0,19,A9,FF,BB,12,91,A0,00 60510 DATA 20,1C,1D,B1,4E,BD,10,91,20,0B,1D,20,44,1D,90,F0,58,60,A9,00,8D,12,91
 60520 DATA A0,00,20,19,1D,91,52,20,3E,1D,90,F6,58,60,AD,1C,91,29,DF,8D,1C,91,09 60530 DATA E0,8D,1C,91,60,20,0B,1D,AD,1D,91,29,10,F0,F9,AD,10,91,60,20,FD,CE,20 60540 DATA 9E,CD,A5,0D,D0,08,A5,0E,D0,03,20,F7,D7,60,A2,15,4C,3A,C4,E6,52,D0,02
 60550 DATA E6,53,A5,4F,C5,51,90,08,D0,0C,A5,4E,C5,50,B0,06,E6,4E,D0,02,E6,4F,60
  60560 DATA *
  60600 DATA 40448, 38389: REM
60610 DATA A0448, 38389; KEM
60610 DATA A0490, 85,80,4C,38,9E,A9,4D,D0,02,A9,CD,85,BD,20,27,9F,A5,15,48,A5,14
60620 DATA 48,20,27,9F,A5,15,48,A5,14,48,20,27,9F,A5,14,85,52,A5,15,85,53,68,85
60630 DATA 50,68,85,51,68,85,4E,68,85,4F,A9,00,8D,00,018,AD,00,018,29,00,8D,00,08
60640 DATA 60,02,DD,09,04,8D,02,DD,A9,7F,8D,0D,DD,78,AD,0D,DD,DD,00,0D,70,48D
60650 DATA 00,DD,A5,BD,D0,18,8D,03,DD,20,08,9F,A0,06,88,D0,FD,AD,0D,D2,91,FD
60650 DATA 00,DD,A5,ED,D0,18,BD,20,08,PF,A0,06,8B,D0,FD,AD,DD,D29,10,F0 60660 DATA F1,AD,0D,DD,D29,00,AD,0D,DD,29,10,F0 60660 DATA F1,AD,0D,DD,DA2,00,AD,0D,DD,29,FE,BD,00,DD,D29,10,F0,02,DD,09,AD,0D,DA9,FF 60680 DATA 10,F0,F0,D0,00,AD,0D,A0,0D,D1,B29,FE,BD,00,DD,A2,00,A0,00,A0,00,D1,B20,0B,PF,20,1C,9F,95,4E,E8,B8,D0,F4,20,19 60690 DATA 9F,C9,AD,D0,22,F0,39,20,1C,9F,B5,4E,BD,01,DD,20,0B,9F,E8,BB,D0,F1,20 60700 DATA 1C,9F,A5,BD,48,BD,01,DD,20,0B,9F,E8,AE,D0,1F1,20 60710 DATA 20,1C,9F,B1,4E,BD,01,DD,20,0B,9F,E8,E8,C9,4D,D0,19,A9,FF,BD,3D,A0,00 60710 DATA 20,1C,9F,B1,4E,BD,01,DD,20,0B,9F,20,44,9F,90,F0,58,60,A9,00,8D,03,DD 60720 DATA A0,00,20,19,9F,91,52,20,3E,9F,90,F6,58,60,AD,00,DD,29,FB,BD,00,DD,09,60730 DATA 40,4BD,00,DD,60,20,0B,9F,AD,00,DD,29,10,F0,F0,AD,01,DD,60,20,FD,AE,20 60730 DATA 40,4BD,00,DD,08,A5,0E,D0,03,20,F7,B7,60,A2,15,4C,3A,A4,E6,52,D0,02 60750 DATA E6,53,A5,4F,C5,51,90,08,D0,0C,A5,4E,C5,50,B0,06,E6,4E,D0,02,E6,4F,60 60760 DATA **
 60760 DATA
```

ERFACI

*PET BASIC2

* PET BASIC4

* VIC

* 64

You also need to do some other things so that your interrupt routine can be entered when an interrupt occurs. It involves re-directing IRQ (PET and VIC), or NMI (Commodore 64).

Redirecting interrupts

The addresses of the start of the IRQ and NMI interrupt routines in ROM are found at fixed locations in ROM on all Commodore machines. You may recall that programs in earlier articles got the address from the IRQ location and used it for machine identification - it varies from machine to machine. The microprocessor is constructed to get it automatically when an IRQ interrupt occurs. The same is true for NMI. But the trail of instructions soon breaks, and continues from a point whose address is held in RAM. Normally the address points straight back into the ROM. Because the pointer is in RAM, you can change its contents to point elsewhere.

Line 290 of 'Double Wrap Trap' actually redirects the interrupts and thereby disables the STOP key (it is restored at line 400). It changes the LO address in the RAM IRQ pointer to make it point to the location just three bytes further on past its normal re-entry point. So it skips the subroutine jump, a three-byte instruction, at that point within the IRQ routine. This jump is to the subroutine, mentioned earlier, which updates the TI clock and tests to see if the STOP key is currently depressed.

The trick of re-directing IRQ to disable 'STOP' seems to work for all Commodore machines. Unfortunately it also stops the Tl clock, which your program may access, as this is updated before the STOP key test and in the same routine. It does not work on a VIC with a 'Super Expander' cartridge plugged in. IRQ is already re-directed elsewhere.

BASIC is slow. You can only alter one byte of the IRQ point from BASIC with a POKE command. This is enough for disabling the STOP key. If you tried to alter both bytes to point to a new LO-HI address, an interrupt would probably occur before the second POKE could be executed and the machine would crash. So you have to do that from an assembler program.

The interrupt trail

I pointed out earlier that NMI is the user port interrupt on the Commodore 64. PET and VIC use IRQ. Here are their trails. I suggest that you use a monitor cartridge, or 'Extramon' (or its equivalent) to follow the trail and see what happens at each point:

ROM Pointer at \$FFFE-F \$FFFE-F \$FFFE-F	Points to start \$E616 \$E442 \$FF72 \$FE43	Then RA Pointer a \$90-\$91 \$90-\$91 \$0314-\$0 \$0318-\$0	t)315	Points to main \$E62E \$E455 \$EABF \$FE47
59457 III		Register A Direction A	(DR)	
59467 000 59468 11 59469	O Peripho Interro	ry Control eral Control upt Flags upt Enable	(AC) (PC,HI (IC,HI (IE)	
Fig 1	1 - PET Us	ser Port (Chip	
37136 III 37138 III		Register B Direction B	(DR) (DD)	
The state of the s	011 Periph Interr	ry Control eral Control upt Flags upt Enable	(AC) (PC,HI (IC,HI (IE)	
Fig 7	2 - VIC Us	ser Port	Chip	
56576 56577 56578 56579	Data F	Register A Register B Direction A Direction B	(HS) (DR) (HE) (DD)	
56589	Interru	upt Control	(IC,IE	(,НТ)

Routine

ends at

\$F6F4

\$E600

\$EB19

\$FEBC

Fig 3 - CBM64 User Port Chip

REM VARLINK	W.OWEN MURCOTT	REV. DEC 1983
		PET BASIC2
	A.DO.02.49.DA.85.00.20.E8.CD	
DATA A2.05.20.D6.7C.A0.00.F0.0	F.A0.02.B1.44.85.20.88.B1.44	.85.1F.88.E1.44
DATA 20,D6,7C,20,CC,7C,58,60,8	6,1F,38,A5,30,E5,1F,85,30,A5	31,E9,00,85,31
DATA 38,A5,30,E9,02,85,30,85,3	2,85,1F,85,40,A5,31,E9,00,85	,31,85,33,85,20
DATA 85,41,C5,2F,90,0A,D0,0B,A	5,30,C5,2E,90,02,D0,03,4C,55	C3,E0,00,F0,03
DATA 20,CC,7C,98,18,65,1F,85,1	F,90,02,E6,20,A0,00,A9,2C,91	,1F,85,04,A9,3A
DATA 85,03,A9,98,85,0B,A5,77,A	4,78,85,48,84,49,A5,40,A4,41	,85,77,84,78,20
DATA 67,D3,20,BD,D6,20,E2,C8,A	5,48,44,49,85,77,84,78,58,60	AD,4C,E8,29,DF
DATA 8D,4C,E8,09,E0,8D,4C,E8,6	0,20,80,7C,AD,4D,E8,29,02,F0	,F9,AD,41,E8,60
DATA 20,BE,7C,91,1F,C8,CA,D0,F	7,60,A5,44,85,1F,A5,45,85,20	,60
DATA *		
DATA 31488, 57488: REM		PET BASIC4
DATA 84,47,A9,00,8D,4B,E8,AD,4	C,E8,29,FE,8D,4C,E8,AD,4C,E8	,09,E0,8D,4C,E8
	REM- DATA 31488, 57815: REM DATA 49,00,85,00,4C,19,7B,A9,5 DATA 84,47,A9,00,8D,4E,E8,AD,41,E DATA 78,A9,02,8D,4E,E8,AD,41,E DATA E8,20,80,7C,A0,07,88,D0,F DATA 4D,E8,29,02,F0,02,D0,09,A DATA 4D,E8,AE,41,E8,09,E0,8D,4 DATA 62,E8,AE,41,E8,09,E0,7C,A5,0 DATA 20,C9,CF,85,46,84,47,48,C DATA 07,8D,41,E8,20,8E,7C,A5,0 DATA 62,05,20,D6,7C,A0,00,F0,A DATA AA,20,C1,7C,8E,41,E8,20,B DATA 80,47,C8,CA,D0,F1,58,60,A DATA 20,D6,7C,20,CC,7C,58,60,8 DATA 83,A5,30,E9,02,28,50,85,35 DATA 85,41,C5,2F,90,0A,D0,0B,A DATA 67,D3,20,BD,D6,20,E2,C8,A DATA 80,4C,E8,09,E0,BD,4C,EB,6 DATA 80,EF,7C,91,1F,C8,CA,D0,F DATA * DATA 31488, 57488: REM DATA 31488, 57488: REM DATA 31488, 57488: REM	REM- DATA 31488, 57815; REM DATA 49,00,85,00,4C,19,7B,A9,56,D0,02,A9,D6,85,00,20,F8,CD DATA 84,47,A9,00,8D,4B,E8,AD,4C,E8,29,FE,8D,4C,E8,AD,4C,E8 DATA 78,A9,02,8D,4E,E8,AD,41,E8,AD,4C,E8,09,E0,8D,4C,E8,AD DATA 88,20,80,7C,A0,07,88,D0,FD,AD,4D,E8,29,02,F0,F1,AD,41 DATA 4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29,02,F0,F1,AD,41 DATA 4D,E8,29,02,F0,02,D0,09,AD,4D,E8,29,02,F0,F0,D0,00,AD DATA 4C,E8,AE,41,E8,09,E0,8B,4C,E8,A7,FF,8D,43,E8,4C,AF,7B DATA EE,7C,85,07,20,BE,7C,85,48,20,BE,7C,55,42,20,BE,7C,85,DATA 20,C9,CF,85,46,84,47,68,C9,56,D0,30,F0,6D,A5,00,8D,41 DATA 07,8D,41;E8,20,BE,7C,A5,08,8D,41,E8,20,BE,7C,A5,42,8D DATA A5,43,8D,41,E8,20,E0,7C,A5,00,C9,56,D0,37,A9,FF,8B,43 DATA A2,05,20,D6,7C,A0,00,F0,0F,A0,02,B1,44,85,20,B8,B1,44 DATA AA,20,C1,7C,8E,41,E8,20,B0,7C,E0,00,F0,0F,20,C1,7C,B1 DATA 20,D6,7C,20,CC,7C,58,60,86,1F,38,A5,30,E5,1F,85,30,A5 DATA 38,A5,30,E9,02,85,30,85,32,85,1F,85,40,A5,31,E9,00,85 DATA 85,41,C5,2F,90,0A,D0,0B,A5,30,C5,2E,90,02,D0,03,AC,55 DATA 85,41,C5,2F,90,0A,D0,0B,A5,70,C2,E6,20,A0,00,A9,2C,91 DATA 85,03,A9,98,85,0B,A5,77,A4,78,85,48,84,49,A5,40,A4,1 DATA 67,D3,20,ED,D6,20,E2,C6,A5,A8,A4,49,85,1F,A5,45,85,60 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,B0,7C,AD,4D,E8,29,02,F0 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,8D,7C,AD,4D,E8,29,02,F0 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,8D,7C,AD,4D,E8,29,02,F0 DATA 8D,4C,E8,09,E0,8D,4C,E8,60,20,8B,7C,AD,4D,E8,29,02,F0 DATA 8D,4C,E8,60,20,BD,7T,60,A5,44,85,1F,A5,45,85,20

INTERFACING

60600 DATA 6656. 51300: REM

Add your own

You can change the RAM pointers to point to your own user port routines, written in assembler, which will then be executed each time an interrupt occurs. When you change the pointers, you must disable IRQ interrupts first, using SEI. It would be disastrous if an interrupt happened before the change was completed. Be systematic and preserve the present content of the pointers so that they can be restored. Then reenable interrupts with CLI.

I have given some sample code, labelled 'IRQLINK', at the end of this article which shows how to do it. It allows your own interrupt routines to be enabled/disabled at will by using alternative entry points 'ENABL' and 'DISABL'.

Beware of cassette tape transfers. They sometimes have a nasty habit of not working if the IRQ pointers do not have their normal values at the start. Also they reset the pointers back to their normal values at the end. Then your interrupt routine will never be entered. So avoid cassette tape usage if you alter the pointers, or make sure that you reset them before and after tape transfers. I have not yet had a chance to find all of the 'nasties' which lie in store for you with NMI pointers on the CBM64.

What to do on interrupt

Once you have redirected the interrupt trail to run through your own routine, remember that all interrupts will follow it. You need to be able to distinguish those which have come from the user port interface chip, and those which have arisen from other sources. The latter must be immediately redirected back to the normal interrupt processing in ROM.

If the interrupt has stemmed from the user port interface chip, bit 7 of the Interrupt Flag Register (Interrupt Control Register on the Commodore 64) will be set. When it is caused by a handshake, the appropriate interrupt flag will also be set in that register. Logical AND, using the value for enabling the interrupt (see above), will detect it (look at label 'OWNCDE' in my sample code with this article). You can then take action accordingly, and when it is complete go on to the interrupt end address in ROM where the stack is tidied (given above).

```
10 REM VARLINK W.OMEN MURCOTT REV. DEC 1983 59999 REM VIC - ALTERNATIVE VERSION OF VARLINK 60610 DATA 7168, 51350: REM VIC - ALTERNATIVE VERSION OF VARLINK 60610 DATA A9,00,85,00,4C,19,1C,A9,56,D0,02,A9,D6,85,00,20,FD,CE,20,8E,D0,85,49 60620 DATA 84,4A,A9,00,8B,1B,91,AD,1C,91,29,EF,BD,1C,91,AD,1C,91,90,E0,BD,1C,91,800,BD,1E,91,AD,10,91,AD,1C,91,90,E0,BD,1C,91,AD,10,91,E,BD,12,60640 DATA 78,A9,10,8D,1E,91,AD,10,79,AD,1D,91,29,10,F0,F1,AD,10,91,4C,85,1C,AD 60650 DATA 1D,91,29,10,F0,02,D0,09,AD,1D,91,29,10,F0,F1,AD,10,91,4C,85,1C,AD 60650 DATA 1C,91,AE,10,91,09,E0,BD,1C,91,AP,FF,BD,12,91,4C,AF,1C,20,C1,1D,4B,20,60640 DATA 20,F7,D0,85,49,84,4A,68,C9,56,D0,3F,F,BD,12,91,4C,AF,1C,20,C1,1D,4B,20,60670 DATA 8E,1D,85,0D,20,BE,1D,85,0E,20,BE,1D,85,45,20,BE,1D,85,46,A9,00,85,0C 60680 DATA 20,F7,D0,85,49,84,4A,68,C9,56,D0,3F,F0,FF,BD,12,91,4C,AF,1C,20,C1,1D,AB,20,6090 DATA 20,F7,D0,85,49,84,4A,68,C9,56,D0,3F,F0,FF,BD,12,91,A5,40,R9,00,85,0C 60690 DATA 30,580,10,91,20,BE,1D,A5,0E,BD,10,91,20,BE,1D,A5,45,BD,10,91,20,BE,1D,A5,60,BD,10,91,20,BE,1D,A5,45,BD,10,91,20,BE,1D,A5,60,BD,10,91,20,BE,1D,A5,45,BD,10,91,20,BE,1D,A5,46,BP,10,BP,14A,85,23,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8B,B1,47,85,22,8
```

60610 DATA A9,00,85,00,4C,19,1A,A9,56,D0,02,A9,D6,85,00,20,FD,CE,20,8B,D0,85,49

```
60620 DATA 84,44,A9,00,8D,1B,91,AD,1C,91,29,EF,8D,1C,91,AD,1C,91,09,E0,8D,1C,91
60630 DATA 78,A9,10,8D,1E,91,AD,10,91,AD,1C,91,09,E0,8D,1C,91,A5,00,D0,18,8D,12
 60690 DATA 0D,8D,10,91,20,BE,1B,A5,0E,8D,10,91,20,BE,1B,A5,45,8D,10,91,20,BE,1B
60700 DATA A5,46,8D,10,91,20,B0,1B,A5,00,C9,56,D0,3F,A9,FF,8D,12,91,A5,0D,D0,09
60710 DATA A2,05,20,D6,1B,A0,00,F0,0F,A0,02,B1,47,85,23,88,B1,47,85,22,88,B1,47
 60/720 DATA AA,20,C1,18,8E,10,91,20,80,18,E0,10,F0,0F,20,C1,18,B1,22,80,10,91,20
60/730 DATA 80,18,C8,CA,D0,F1,58,60,A9,00,80,12,91,20,8E,18,AA,A0,00,A5,0D,D0,08
60/740 DATA 20,D6,18,20,CC,18,58,60,86,22,38,A5,33,E5,22,85,33,A5,34,E9,00,85,34,65,33
60/740 DATA 38,A5,33,E9,02,85,33,85,35,85,22,85,43,A5,34,E9,00,85,34,85,36,85,23
60/740 DATA 85,44,C5,32,90,0A,D0,08,A5,33,C5,31,90,02,D0,03,4C,35,C4,E0,00,F0,03
  60770
                                         20,CC,1B,98,18,65,22,85,22,90,02,E6,23,A0,00,A9,2C,91,22,85,08,A9,3A
 60780 DATA 85,07,A9,98,85,11,A5,7A,A4,7E,85,4E,84,4C,A5,43,A4,44,85,7A,B4,7E,20
60790 DATA 8D,D4,20,E2,D7,20,DA,C9,A5,4E,A4,4C,85,7A,84,7E,58,60,AD,1C,91,29,DF
 60800 DATA 8D,1C,91,09,E0,8D,1C,91,60,20,80,1B,AD,1D,91,29,10,F0,F9,AD,10,91,60
  60820 DATA
  60900 DATA 39936, 56263: REM
  60910 DATA A9,00,85,BD,4C,19,9C,A9,56,D0,02,A9,D6,85,BD,20,FD,AE,20,8B,B0,85,49
 60920 DATA 84,4A,A9,00,8B,EC,07,AD,EC,07,29,00,8D,EC,07,AD,02,DD,09,04,8D,02,DD 60930 DATA 78,A9,7F,8D,0D,DD,AD,0D,DD,AD,00,DD,09,04,8D,00,DD,A5,BD,D0,18,8D,03 60940 DATA DD,20,80,9D,A0,06,88,D0,FD,AD,0D,DD,29,10,F0,F1,AD,0D,DD,4C,85,9C,AD
60940 DATA 0D,20,80,90,A0,06,88,D0,FD,AD,0D,DD,29,10,F0,F1,AD,0D,DD,4C,85,9C,AD 60950 DATA 0D,DD,29,10,F0,02,D0,09,AD,0D,DD,29,10,F0,F0,D0,00,AD,00,DD,29,FB,8D 60960 DATA 00,DD,29,10,F0,00,DD,09,40,FF,8D,03,DD,4C,AF,9C,20,C1,9D,46,20 60970 DATA 8E,9D,85,0D,20,8E,9D,85,0E,20,8E,9D,85,46,A9,00,85,0C 60980 DATA 2D,E7,80,85,49,84,4A,68,C9,56,D0,30,F0,6D,A5,8D,8D,01,DD,20,8E,9D,A5 60990 DATA 0D,8D,01,DD,20,8E,9D,A5,6D,01,DD,20,8E,9D,A5,6D,01,DD,20,8E,9D 61000 DATA A5,46,8D,01,DD,20,8E,9D,A5,8D,C9,56,D0,3F,A9,FF,8D,03,DD,A5,0D,D0,09 61010 DATA A2,05,20,D6,9D,A0,00,F0,6D,A5,8D,C9,56,D0,3F,A9,FF,8D,03,DD,A5,DD,00,09 61010 DATA A2,05,20,D6,9D,A0,00,F0,6D,0F,A0,02,8E,9D,A5,8D,FF,8D,03,DD,A5,0D,D0,09 61030 DATA A2,05,20,D6,9D,A0,00,F0,9D,F0,0F,A0,02,8E,9D,A0,4D,A5,2D,B0,2D,A5,0D,D0,08 61040 DATA 20,D6,D0,C8,CA,D0,F1,58,60,A9,00,8D,03,DD,20,8E,9D,AA,A0,00,A5,0D,D0,08 61040 DATA 20,D6,9D,20,E0,9D,58,60,86,22,38,A5,33,E5,22,85,23,85,33,A5,34,E5,00,85,34,85,33,85,35,85,22,85,33,45,34,E5,00,85,34,85,33,85,35,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,85,33,
 61050 DATA 38,A5,33,E9,02,85,33,85,35,85,22,85,43,A5,34,E9,00,85,34,85,36,85,23
61060 DATA 85,44,C5,32,90,0A,D0,0B,A5,33,C5,31,90,02,D0,03,4C,35,A4,E0,00,F0,03
61070 DATA 20,CC,9D,98,18,65,22,85,22,90,02,E6,23,A0,00,A9,2C,91,22,85,08,A9,3A
 61080 DATA 85,07,A9,98,85,11,A5,7A,A4,7E,85,4B,84,4C,A5,43,A4,44,85,7A,84,7E,20
61090 DATA 8D,84,20,E2,B7,20,DA,A9,A5,4B,A4,4C,85,7A,84,7B,58,60,AD,00,DD,29,FB
61100 DATA 8D,00,DD,09,04,8D,00,DD,60,20,B0,9D,AD,0D,DD,29,10,F0,F9,AD,01,DD,60
  61110 DATA 20,BE,9D,91,22,C8,CA,D0,F7,60,A5,47,85,22,A5,48,85,23,60
  61120 DATA *
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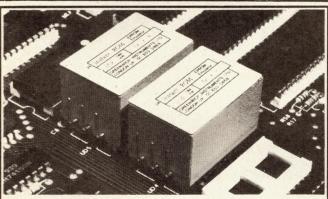
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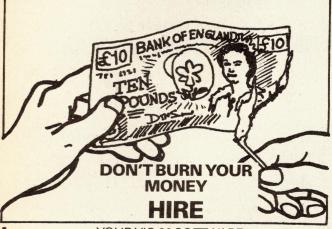
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Features of the 64

More useful ideas and information about the Commodore 64, including how to use the built in error messages of the 64 and interesting effects created by the SID chip. But first, how to use the interrupt generated by the Raster Compare register.

When writing machine code routines, you sometimes require an error message to be displayed if a check in your program creates one. Most of the Basic and Kernal routines will create their own messages if certain values are not to their liking. But you may want to test values and give error messages out of bounds. There are some routines that are there for displaying certain messages but not all.

Here we will list all of the error messages and how to send them. It must be noted that there is no error number zero. Any error message above \$1E will be displayed as a weird character and any error number above \$7F will be ignored. To display a certain error, the machine code is as follows:

LDX #number JMP \$A437

e.g. LDX #\$14 JMP \$A437

Will display the message: ?DIVISION BY ZERO ERROR

The address given for each message is the address in memory where the start of the message appears.

MESSAGE	MESSAGE NUMBER	ADDRESS OF MESSAGE
TOO MANY FILES	\$01	\$A19E
FILE OPEN	\$02	\$A1AC
FILE NOT OPEN	\$03	\$A1B5
FILE NOT FOUND	\$04	\$A1C2
DEVICE NOT PRESENT	\$05	\$A1D0
NOT INPUT FILE	\$06	\$A1E2
NOT OUTPUT FILE	\$07	\$A1F0
MISSING FILE NAME	\$08	\$A1FF
ILLEGAL DEVICE NUMBER	\$09	\$H210
NEXT WITOUT FOR	\$0A	\$A225
SYNTAX	\$0B	\$A235
RETURN WITHOUT GOSUE	\$9C	\$A23B
OUT OF DATA	\$0D	\$H24F
ILLEGAL QUANTITY	\$0E	\$A25A
OVERFLOW	\$0F	\$A26A
OUT OF MEMORY	\$10	\$A272
UNDEF'D STATEMENT	\$11	\$A27F
BAD SUBSCRIPT	\$12	\$A290
REDIM'D ARRAY	\$13	\$A29D
DIVISION BY ZERO	\$14	\$R2AA
ILLEGAL DIRECT	\$15	\$A2BA
TYPE MISMATCH	\$16.	\$A2C8
STRING TOO LONG	\$17	\$A2D5
FILE DATA	\$18	\$R2E4
FURMULA TOO COMPLEX	\$19	\$A2ED
CAN'T CONTINUE	\$1A	\$A300
UNDEF'D FUNCTION	\$1B	\$A30E
VERIFY	\$1C	\$A31E
LOAD	\$1D	\$8324
BREAK	\$1E	\$A383

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HINTS AND TIPS

```
5 GOSUB11000
10 POKE53280,2:POKE56334,PEEK(56334)AND254
20 SYS49152: POKE49206, 1
30 I=50:GOSUB100
40 A=PEEK(56320)
50 IF((AAND2)=0)ANDI(210THENI=I+2
60 IF((AAND1)=0)ANDI)50THENI=I-2
70 GOSUB100
80 IF(AAND16)=0THENPOKE56334,PEEK(56334)OR1:END
.90 GOTO40
100 POKE49232, I: POKE49211, 40+I: RETURN
10000 DATA120,169,34,141,20,3,169
10010 DATA192,141,21,3,173,17,208
10020 DATA41,127,141,17,208,169,151
10030 DATA141,18,208,173,26,208,9
10040 DATA1,141,26,208,88,96,169
10050 DATA1,44,25,208,208,3,76
10060 DATA49,234,173,33,208,41,15
10070 DATA201,2,208,21,169,1,141
10080 DATA33,208,169,90,141,18,208
10090 DATA169,1,141,25,208,104,168
10100 DATA104,170,104,64,169,2,141
10110 DATA33,208,169,50,141,18,208
10120 DATA76,63,192,-1
11000 I=49152
11010 READA: IFA = - 1THEN 11050
11020 POKEI, A: I=I+1
11030 T=T+A
11040 GOTO11010
11060 IF I⇔49239 THEN PRINT"NNUMBER OF DATA ERROR":END
11070 RETURN
READY.
```

Raster Interrupts.

A very useful part of the 64's VIC chip is the way that interrupts can be caused by the raster register. This can be very useful for producing 'Split Screens' as in The Hobbit.

The raster scans down the television screen and puts onto the screen the information sent to it by the computer. There are two registers that affect the raster. These are locations \$D012 (53266) which is the low byte of the raster position, and \$D011 (53265) which holds in its highest bit the high bit of the raster position. These locations can be read to get the current raster position.

The raster value goes between 0 and 320 (it is very hard to find the maximum value) but the only values that are actually on the screen are between 51 and 251 not including the border. This means that for most purposes the highest bit is never needed.

There is a use, however, for the highest bit: A lot of games boast the fact that they have flicker free sprites and graphics. The high bit can be WAITed for in Basic to produce flicker free displays. The method of doing so is to use the line following:

WAIT53265,128:WAIT53265,128,128

This first waits for the high bit to become 1 and then for the high bit to become zero. Just waiting for it to become 1 will not work and the wait will be about halfway down the first line on the screen. A short program to test the usefulness of the screen wait is as follows. If you want to see how it would look without the wait, insert REM at the beginning of line 20.

10 FORI=0TO15

20 WAIT53265,128:WAIT53265,128,128

30 POKE53281.I 40 NEXT 50 GOTO10

This program just changes the screen colour using the screen wait.

This is fine when you just wish to intercept the raster at the top of the screen but in some cases, it could be useful to stop it at other places on the screen. This is where the raster interrupt comes into being. The two registers mentioned earlier have a second purpose, that of setting a raster compare value. When this value has been set and bit 0 of location \$D01A (53274) has been set to a 1, each time the raster value is the same as the raster compare value, an interrupt is forced and if you have a routine 'wedged' into interrupts to carry out this interrupt, it can be used. The way to test if it is a normal interrupt or a raster

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one is done at SPLIT1 in the disassembly following. If it was not caused by the raster, a jump to the normal interrupts is done, but if it was caused by the raster. then our own routine is carried out.

When the change has been done, a 1 is written to the VIC interrupt register and return to normal operation.

In the routine, there are two parts depending on the present screen colour, one changes the colour of the background at the top of the screen and the

other changes the colour at the halfway point on the screen. This is the easiest form of split screen use where the screen background colour is actually two colours, red at the top and purple at the bottom. This could easily be changed to, say, two different text screens, a text screen and a hi-res etc.

One last point to mention about the split screen routine is that with the standard keyboard scanning routine still working, the split is slightly untidy especially when a key is pressed.

The basic program included has the data for the machine code routine and a little program that allows you to change the top and bottom coordinates of the raster compare using the joystick. When running, the keyboard has been switched off so that the lines are neat and to exit the program, press stop restore or the fire button on the joystick. Experiment with the directions on the joystick for moving the split.

1000 *=\$C000 !	START ADDRESS OF CODE	
1010 1020	3EI LDA #<\$PLIT1	! DISABLE IRQ ! NEW IRQ LO
1930	STA \$0314	PER IND LO
1949 1950	LDA #>SPLIT1 STA \$0315	MEN IRQ HI
1060	LDA \$D011	! RASTER SCAN HI BIT
1070 1080	AND #\$7F STA \$D011	
1090	LDA #\$97	
1100 1105	5TA \$D012 LIA \$D01A	! RASTER SCAN LO BYTE
1119	ORA #\$01	•
1140 1150	P/STA ≸D01A CLI	ENABLE RASTER IRQ
1160	RTS	
1170 SPLIT1 1180	LDA #\$01 BIT \$D019	! TEST IF RASTER !IRQ HAS OCCURED
1190	ENE CHANGE	! IF NOT. JUMP
1200 1210 CHANGE	JMP *EA31 / LDA *D021	!TO NORMAL IRQ ! CHECK IF SCREEN
1211	PND #\$0F CMP #\$02	COLOUR IS RED
1213	ENE CHANGE!	HO.
1219 1220	LDA #\$04 STA \$D021	! CHANGE SCREEN !COLOUR TO PURPLE
1230	LDA #\$00	SET RASTER COMPARISON
1235	STA \$D012 LDA #\$01	!TO TOP OF SCREEN : TELL COMPUTER THAT
1240 EXIT 1250	ETA \$D019	RASTER IRQ HAS BEEN DONE
1300 1301	PLA : TAY	! FULL REGISTERS AND RETURN !FROM INTERRUPTS
1302	FLA	
1383 1384	TAX PLA	
1319	RTI	
1380 CHANGE1	LBA #\$02 3TA \$D021	! SCREEN IS PURPLE CHANGE !TO RED
1400 1410	LDA #\$97 STA \$D012	! SET RASTER COMPARE TO
1420	JMP EXIT	!HALFWAY DOWN SCREEN ! EXIT IRQ

HINTS AND TIPS

This program shows how the sync and ringmod bits in the SID chip control registers can be used to produce interesting sound effects. They are both done by setting a single tone into voice 3 and scanning up and down the scale for voice 1 with the ring-mod or sync set for voices 1 and 3.

10 S=54272 20 GOSUB63000

30 PRINT": PRESS KEY FOR REQUIRED SOUND: "

40 PRINT" SUCCESSION TARDIS (DEMO OF RING MOD)"

50 PRINT"MUMMORPHE: DEMO OF SYNC"

65 PRINT" MUNICIPALITIES AND THER"

70 GETA\$:IFVAL(A\$)<10RVAL(A\$)>2THEN70

90 ONVAL(A\$)GOTO1000,2000

1000 POKES+24,15:POKES+5,0:POKES+6,240

1010 POKES+4,21

1020 POKES+15,19:POKES+14,136

1030 FORK=0T065535STEP1500:GOSUB4000:NEXT 1040:FORK=65535T00STEP-1500:GOSUB4000:NEXT

1050 GOT01030

2000 POKES+24,15:POKES+5,0:POKES+6,240

2010 POKES+4,35

2020 POKES+15,19:POKES+14,136

2030 FORK=0T065535\$TEP600:GO\$UB4000:NEXT 2040 FORK=65535T00\$TEP-600:GO\$UB4000:NEXT

2050 GOTO2030

4000 POKES+1, INT(K/256): POKES, K-INT(K/256) *256

4010 GETA\$: IFA\$<>""THENRUN

4020 RETURN

63000 FORI=0T024

63010 POKES+I,0: NEXT: RETURN

READY.

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BASIC PROGRAMMING

Speedier utilities

This month we have a program to display track and sector on disk. The slow routines have been written in Machine Code to speed up the process.

The utility disk supplied with Commodore disk units contains a program that displays, in hexadecimal form, the contents of specified sectors on disk. Unfortunately, as the program is written entirely in Basic, you feel you have enough time to eat a three-course meal in the time it takes to display a full screenful of information! The parts that take up all of this time are the read from disk and conversion of decimal numbers, held in an array, to hex and ASCII characters.

By rewriting these slower sections in machine code, I have produced a version that can display to the screen almost instantly and output to a printer as fast as the print head can print. There are two main parts to the machine code; the first reads the specified block into memory just above Basic, and the second (this has two entry points, one for the first 128 bytes displayed and the other for the second 128) displays it to either the screen or printer.

As the program needs 256 bytes of memory that is safe from Basic (for the block), the End of Basic pointer has been lowered so that only around 6K is available to Basic. I have set it this low to maintain compatibility between 8, 16 and 32K machines - so you will have to reset the computer after you have finished using the program (or alter

locations 52/3 back to their original values).

Both Basic 2.0 and Basic 4.0 are catered for without changes (a check is made at lines 210-240), and disk units 3040, 4040 and 2031 can be used. A small change to line 470 should allow the use of the 8050 and 8250 drives. (I say 'should' as I have no way of testing this out!) Alter T>35 to T>77 for the 8050 and to T>154 for the 8250.

This change should allow access to the extra tracks that are available on these units. There is no check in the program for the amount of sectors the user enters as these vary between the different machines; any errors will be taken care of by the disk operating system which will halt the program with error 66 (ILLEGAL TRACK OR SECTOR).

If you are using a 2031 single drive then enter 'S' when prompted for the drive number as this will tell the program to set up the address for the disk buffer in the correct place for this unit - all dual drives use address \$1100 while the 2031 (and the 1541) uses \$0300.

To exit the program type 'x' (+ return) when asked to enter the next track number. Typing 'x' in response to 'SECTOR' will take you back one step to 'TRACK'. Also, the space bar may be used instead of 'Y' (for 'yes') when asked

if you want to continue to the next track and sector displayed. The 'bomb proof input' subroutine at line 810 prevents dropping back to Basic on the PET/CBM (or accidently continuing, without having entered anything, to the next statement on the CBM-64).

The program has been liberally sprinkled with REMs to help users understand how it works. The "I" part in line 400 is only really needed for the older 3040 drive as all the later ones automatically initialise themselves as soon as a disk is inserted; but don't miss out the OPEN15,8,15 as it is needed for all drives.

The second listing shows the modifications needed to enable the program to run on the CBM-64. The changes are mainly the removal of drive number references, not needed for the single drive 1541; and the relocation of the machine code section. The PFT/CRM version has the machine code in the first cassette buffer while the 64 version has it above Basic.

Also an extra routine is added to make up for the lack of a hexadecimal number output routine; this is part of the m/c monitor in the PET/CBM and totally missing in the 64. This version should also run on the Vic providing it has got the full 29K expansion, but the screen display will be rather ragged due to its 22 columns.

M/C DISPLAY

- 100 REM ** DISPLAY T & S (MACHINE CODE VERSION) D. VINER - JAN 1984 ** 110 REM ** FOR USE ON BASIC 2/4 PET/CBM (8-32K) PLUS 3040/4040/2031 DRIVES **
- 130 REM * ADJUST MEMORY POINTER *
- 140 POKE52,0: POKE53,30: POKE59468,12: PRINTCHR\$(142): CLR
- 160 REM * SET UP MACHINE CODE *
- 170 A=640
- 180 READB: IFB=999THEN220
- 190 POKEA, B: A=A+1: GOTO180
- 210 REM * CHECK FOR BASIC 2 OR 4 *
- 220 IFPEEK (65534) = 27ANDPEEK (65535) = 230THENPOKE767, 117: POKE768, 231: GOTO270
- 230 IFPEEK (65534) = 66ANDPEEK (65535) = 228THENPOKE767, 34: POKE768, 215: GOTO270
- 240 PRINT" TOOMS ROM TYPE NOT RECOGNISED ":STOP
- 250 :
- 260 REM * SCREEN DISPLAY *

BASIC PROGRAMMING

```
270 PRINT" INTERNAL
 280 PRINT"
              # DISPLAY TRACK & SECTOR XXX"
 290 V=17: REM * SET START OF DISK BUFFER (GETS CHANGED TO 3 FOR 2031) *
 300 PRINT" WEDRIVE : 011"; : GOSUBB10; D$=LEFT$(X$.1)
 310 IFD$="S"THENV=3:D$="0":GOTO330:REM * ENTER 'S' FOR 2031 *
 320 IFD$<>"0"ANDD$<>"1"THEN270
 330 PRINT"XXXDISPLAY ON SSECREEN OR SPERINTER"
 340 GETJ$: IFJ$=""THEN340
 350 IFJ$="S"THENOPEN4,3:GOTO400
 360 IFJ$="P"THENOPEN4,4:60T0400
 370 GOTO340
 380 :
 390 REM * OPEN FILES TO DISK *
 400 OPEN15,8,15,"I"+D$:GOSUB770:REM * INITIALISE (ONLY NEEDED ON 3040) *
 410 OPEN2,8,2,"#"+"0":GOSUB770:REM * RESERVE DISK BUFFER 0 *
 430 REM * GET TRACK & SECTOR *
 440 POKE158,0:PRINT" TRACK : "::GOSUB810:T=VAL(X$)
 450 :
 460 REM * IF 'X' OR NON-VALID TRACK NO. IS ENTERED THEN PROGRAM EXITS *
 470 IFT=00RT>350RX$="X"THENPRINT#15,"I"D$:CLOSE2:CLOSE4:CLOSE15:PRINT"U":END
 480 PRINT, , "JSECTOR : "; : GOSUB810: IFX$="X"THEN440
 490 S=VAL (X$)
 500 IFJ$="S"THENPRINT"TRACK"T"SECTOR"S"X"
 510 IFJ$="P"THENPRINT#4."TRACK"T"SECTOR"S
 530 REM * GET BLOCK INTO MEMORY *
 540 PRINT#15, "U1:2, "D$; T; S:GOSUB770: REM * READ BLOCK FROM DISK TO BUFFER *
 550 PRINT#15, "B-P:2,1": REM * SET BUFFER POINTER *
 560 PRINT#15, "M-R"CHR$ (0) CHR$ (V)
 570 GET#15,A$:A$=A$+CHR$(0):REM * GET 1ST BYTE OF BLOCK *
 580 POKE7936,ASC(A$):SYS640:REM * READ REST OF BLOCK INTO MEMORY *
 600 REM * DISPLAY BLOCK ON SCREEN OR PRINTER *
 610 CMD4: SYS659: REM * DISPLAY FIRST HALF OF BLOCK *
 620 IFJ$="P"THEN640
 630 GETZ$:IFZ$=""THEN630:REM * AWAIT KEYPRESS IF DISPLAYING TO SCREEN *
 640 SYS667: PRINT#4: REM * DISPLAY REST OF BLOCK *
 650 :
 660 REM * GET NEXT TRACK & SECTOR *
 670 T1=PEEK (7936): S1=PEEK (7937)
 680 IFT1=0THENPRINT" XXEND OF FILE": GOTO440
 690 PRINT" NEXT TRACK, SECTOR: ";T1;S1
700 PRINT"DO YOU WANT THE NEXT TRACK AND SECTOR?"
 710 GETZ$: IFZ$=""THEN710
 720 IFZ$="Y"ORZ$=" "THENT=T1:S=S1:GOT0500
 730 IFZ$="N"THEN440
 740 GOTO710
 760 REM * CHECK DISK ERROR CHANNEL *
 770 INPUT#15, EN, EM$, ET, ES: IFEN=0THENRETURN
 780 PRINT" DISK ERROR EN, EM$, ET, ES: CLOSE2: CLOSE4: CLOSE15: END
 790 :
 800 REM * BOMB PROOF INPUT ROUTINE *
 810 OPEN9, 0: INPUT#9, X$: CLOSE9: PRINT: RETURN
 820 :
 830 REM * MACHINE CODE DATA *
 840 DATA162,2,32,198,255,160,1,32,207,255,153,0,31,200,208,247
 850 DATA76,204,255,169,31,133,2,169,0,133,1,165,1,32,254,2
 860 DATA169,32,32,210,255,169,58,32,210,255,169,32,32,210,255,160
 870 DATA0,177,1,32,254,2,169,32,32,210,255,200,192,8,208,241
 880 DATA160,0,169,58,32,210,255,169,32,32,210,255,177,1,201,32
 890 DATA144,12,201,96,144,10,201,160,144,4,201,224,144,2,169,32
 900 DATA32,210,255,200,192,8,208,228,169,13,32,210,255,24,165,1
 910 DATA105,8,133,1,201,0,208,1,96,201,128,208,158,96,76,999
READY.
```

BASIC PROGRAMMING

FOR THE COMMODORE-64 REMOVE LINES 210-240 AND 290-320

AND REPLACE ALL THE FOLLOWING :-

- 110 REM ** FOR USE ON CBM-64 & 1541 DISK DRIVE
- 140 POKE55, 0: POKE56, 112: PRINTCHR\$ (142): CLR
- 170 A=28672
- 180 READB: IFB=999THEN270
- 400 OPEN15,8,15:GOSUB770:REM * OPEN ERROR CHANNEL *
- 440 POKE198,0:PRINT"MTRACK : ";:GOSUB810:T=VAL(X\$)
- 470 IFT=00RT>350RX\$="X"THENCLOSE2:CLOSE4:CLOSE15:PRINT"U":END
- 540 PRINT#15, "U1:2, ";0;T;S:GOSUB770:REM * READ BLOCK FROM DISK TO BUFFER *
- 560 PRINT#15, "M-R"CHR\$ (0) CHR\$ (3)
- 580 POKE30720, ASC(A\$): SYS28672: REM * READ REST OF BLOCK INTO MEMORY *
- 610 CMD4: SYS28691: REM * DISPLAY FIRST HALF OF BLOCK *
- 640 SYS28699: PRINT#4: REM * DISPLAY REST OF BLOCK *
- 670 T1=PEEK (30720): S1=PEEK (30721)
- 830 REM * MACHINE CODE DATA >
- 840 DATA162,2,32,198,255,160,1,32,207,255,153,0,120,200,208,247
- 850 DATA76,204,255,169,120,133,181,169,0,133,180,165,180,32,126,112
- 860 DATA169,32,32,210,255,169,58,32,210,255,169,32,32,210,255,160
- 870 DATA0,177,180,32,126,112,169,32,32,210,255,200,192,8,208,241 880 DATA160,0,169,58,32,210,255,169,32,32,210,255,177,180,201,32
- 890 DATA144,12,201,96,144,10,201,160,144,4,201,224,144,2,169,32
- 900 DATA32,210,255,200,192,8,208,228,169,13,32,210,255,24,165,180
- 910 DATA105,8,133,180,201,0,208,1,96,201,128,208,158,96,72,74
- 920 DATA74,74,74,32,150,112,170,104,41,15,32,150,112,72,138,32
- 930 DATA210,255,104,76,210,255,24,105,246,144,2,105,6,105,58,96,999 READY.

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NSIDE BASIC

64 Memory Map

Due to popular demand we are publishing the memory map for the 64. This will come in two parts. The first part, which follows, is a description of the memory location below Basic programming memory. Next month we will publish the explanation of the ROM routines.

0000	0	Chip directional register	0067	103	Series evaluation constant pointer
0001	1	Chip I/O; memory & tape control	0068	104	Accum#1 hi-order (overflow)
0003 -0004	3-4	Float-Fixed vector	0069 -006E	105-110	Accum#2: Exponent, etc.
0005 -0006	5-6	Fixed-Float vector	006F	111	Sign comparison, Acc#1 vs #2
0007	7	Search character	0070	112	Accum#1 lo-order (rounding)
0008	8	Scan-quotes flag	0071 -0072	113-114	Cassette buff len/Series pointer
0009	9	TAB column save	0073 -008A	115-138	CHRGET subroutine; get Basic char
000A	10	0=LOAD, 1=VERIFY	007A -007B	122-123	Basic pointer (within subrtn)
000B	11	Input buffer pointer/# subscrpt	008B -008F	139-143	RND seed value
000D	12	Default DIM flag	0090	144	Status word ST
000D	13	Type: FF = string, 00 = numeric	0091	145	Keyswitch PIA: STOP and RVS flags
000E			0091	145	
	14	Type: $80 = integer$, $00 = floating point$		사용의 하나라 하는 것 같아.	Timing constant for tape
000F	15	DATA scan/LIST quote/memry flag	0093	147	Load = 0, Verify = 1
0010	16	Subscript/FNx flag	0094	148	Serial output: deferred char flag
0011	17	0 = INPUT;\$40 = GET;\$98 = READ	0095	149	Serial deferred character
0012	18	ATN sign/Comparison eval flag	0096	150	Tape EOT received
0013	19	Current I/O prompt flag	0097	151	Register save
0014 -0015	20-21	Integer value	0098	152	How many open files
0016	22	Pointer: temporary string stack	0099	153	Input device, normally 0
0017 -0018	23-24	Last temp string vector	009A	154	Output CMD device, normally 3
0019 -0021	25-33	Stack for temporary strings	009B	155	Tape character parity
0022 -0025	34-37	Utility pointer area	009C	156	Byte-received flag
0026 -002A	38-42	Product area for multiplication	009D	157	Direct = \$80/RUN = 0 output control
002B -002C	43-44	Pointer: Start-of-Basic	009E	158	Tp Pass 1 error log/char buffer
002D -002E	45-46	Pointer: Start-of-Variables	009F	159	Tp Pass 2 err log corrected
002F -0030	47-48	Pointer: Start-of-Arrays	00A0 -00A2	160-162	Jiffy Clock HML
0031 -0032	49-50	Pointer: End-of-Arrays	00A3	163	Serial bit count/EOI flag
0033 -0034	51-52	Pointer: String-storage(moving down)	00A4	164	Cycle count
0035 -0036	53-54	Utility string pointer	00A5	165	Countdown,tape write/bit count
0037 -0038	55-56	Pointer: Limit–of–memory	00A5	166	Tape buffer pointer
0039 -003A	57-58	Current Basic line number	00A0 00A7	167	Tp Wrt ldr count/Rd pass/inbit
003B -003C	59-60	Previous Basic line number	00A7 00A8	168	
003D -003E	61-62	Pointer: Basic statement for CONT	00A9	169	Tp Wrt new byte/Rd error/inbit cnt Wrt start bit/Rd bit err/stbit
003D =003E	63-64	보이 마이트 가게 되었다.		170	
		Current DATA line number	00AA		Tp Scan;Cnt;Ld;End/byte assy
0041 -0042	65-66	Current DATA address	00AB	171	Wr lead length/Rd checksum/parity
0043 -0044	67-68	Input vector	00AC -00AD	172-173	Pointer: tape bufr, scrolling
0045 -0046	69-70	Current variable name	00AE -00AF	174-175	Tape end adds/End of program
0047 -0048	71-72	Current variable address	00B0 -00B1	176–177	Tape timing constants
0049 -004A	73-74	Variable pointer for FOR/NEXT	00B2 -00B3	178–179	Pntr: start of tape buffer
004B -004C	75–76	Y-save; op-save; Basic pointer save	00B4	180	1 = Tp timer enabled; bit count
004D	77	Comparison symbol accumulator	00B5	181	Tp EOT/RS232 next bit to send
004E -0053	78-83	Misc work area, pointers, etc	00B6	182	Read character error/outbyte buf
0054 -0056	84-86	Jump vector for functions	00B7	183	* characters in file name
0057 -0060	87-96	Misc numeric work area	00B8	184	Current logical file
0061	97	Accum#1: Exponent	00B9	185	Current secndy address
0062 -0065	98-101	Accum#1: Mantissa	00BA	186	Current device
0066	102	Accum#1: Sign	00BB -00BC	187-188	Pointer to file name

INSIDE BASIC

00BD)	189	Wr shift word/Rd input char	029E	670	RS232 output pointer
00BE		190	# blocks remaining to Wr/Rd	029F -02A0	671-672	IRQ save during tape I/O
00BF		191	Serial word buffer	02A1	673	CIA 2 (NMI) Interrupt Control
00C0		192	Tape motor interlock	02A2	674	CIA 1 Timer A control log
00C1	-00C2	193-194	I/O start address	02A3	675	CIA 1 Interrupt Log
00C3	-00C4	195-196	Kernel setup pointer	02A4	676	CIA 1 Timer A enabled flag
00C5		197	Last key pressed	02A5	677	Screen row marker
00C6		198	# chars in keybd buffer	02C0 -02FE	704-766	(Sprite 11)
00C7		199	Screen reverse flag	0300 -0301	768–769	Error message link
00C8		200	End-of-line for input pointer	0302 -0303	770-771	Basic warm start link
00C9	-00CA	201-202	Input cursor log (row, column)	0304 -0305	772-773	Crunch Basic tokens link
00CB		203	Which key: 64 if no key	0306 -0307	774–775	Print tokens link
00CC		204	0 = flash cursor	0308 -0309	776–777	Start new Basic code link
00CD		205	Cursor timing countdown	030A -030B	778–779	Get arithmetic element link
00CE		206	Character under cursor	030C	780	SYS A-reg save
00CF		207	Cursor in blink phase	030D	781	SYS X-reg save
00D0	0000	208	Input from screen/from keyboard	030E	782	SYS Y-reg save
	-00D2	209-210	Pointer to screen line	030F	783	SYS status reg save
00D3		211	Position of cursor on above line	0310 -0312	784–785	USR function jump (B248)
00D4		212	0 = direct cursor, else programmed	0314 -0315	788-789	Hardware interrupt vector (EA31)
00D5		213	Current screen line length	0316 -0317	790-791	Break interrupt vector (FE66)
00D6		214	Row where curosr lives	0318 -0319	792-793	NMI interrupt vector (FE47)
00D7		215	Last inkey/checksum/buffer	031A -031B	794–795	OPEN vector (F34A)
00D8	0000	216	# of INSERTs outstanding	031C -031D	796–797	CLOSE vector (F291)
	-00F2	217-242	Screen line link table	031E -031F 0320 -0321	798-799	Set_input vector (F20E)
	-00F4	243-244	Screen color pointer	0322 -0323	800-801	Set-output vector (F250)
	-00F6	245-246	Keyboard pointer	0324 -0325	802-803 804-805	Restore I/O vector (F333) INPUT vector (F157)
	-00F8	247-248	RS-232 Rcv pntr	0326 -0327	806-807	(1101)
	-00FA -010A	249-250	RS-232 Tx pntr	0328 -0329	808-809	()
	-010A -013E	256–266 256–318	Floating to ASCII work area	032A -032B	810-811	(1025)
	-015E	256-511	Tape error log Processor stack area	032C -032D	812-813	()
	-0258	512-600	Basic input buffer	032E -032F	814-815	(1021)
	-0262	601-610	Logical file table	0330 -0331	816-817	(1000)
	-026C	611-620	Device # table	0332 -0333	818-819	(1 1110)
	-0276	621-630	Sec Adds table	033C -03FB	828-1019	SAVE link (F5ED) Cassette buffer
	-0280	631-640	Keybd buffer	0340 -037E	832-894	(Sprite 13)
	-0282	641-642	Start of Basic Memory	0380 -03BE	896-958	(Sprite 14)
	-0284	643-644	Top of Basic Memory	03C0 -03FE	960-1022	(Sprite 15)
0285		645	Serial bus timeout flag	0400 -07FF	1024-2047	Screen memory
0286		646	Current color code	0800 -9FFF	2048-40959	Basic RAM memory
0287		647	Color under cursor	8000 -9FFF	32768-40959	Alternate: ROM plug-in area
0288		648	Screen memory page	A000 -BFFF		ROM: Basic
0289		649	Max size of keybd buffer	A000 -BFFF	49060-59151	Alternate: RAM
028A		650	Repeat all keys	C000 -CFFF	49152-53247	RAM memory, including alternate
028B		651	Repeat speed counter	D000 -D02E		Video Chip (6566)
028C		652	Repeat delay counter	D400 -D41C		Sound Chip (6581 SID)
028D		653	Keyboard Shift/Control flag	D800 -DBFF		Color nybble memory
028E		654	Last shift pattern	DC00 -DC0F	56320-56335	Interface chip 1, IRQ (6526 CIA)
028F	-0290	655-656	Keyboard table setup pointer	DD00 -DD0F		Interface chip 2, NMI (6526 CIA)
0291		657	Keyboard shift mode	D000 -DFFF	53248-53294	Alternate: Character set
0292		658	0 = scroll enable	E000 -FFFF	57344-65535	ROM: Operating System
0293		659	RS-232 control reg	E000 -FFFF	57344-65535	Alternate: RAM
0294		660	RS-232 command reg	FF81 -FFF5	65409-65525	Jump Table, Including:
0295	-0296	661-662	Bit timing	FFC6		- Set Input channel
0297		663	RS-232 status	FFC9		- Set Output channel
0298	0001	664	* bits to send	FFCC		- Restore default I/O channels
	-029A	665	RS-232 speed/code	FFCF		- INPUT
029B		667	RS232 receive pointer	FFD2		- PRINT
029C		668	RS232 input pointer	FFE1		- Test Stop key
029D		669	RS232 transmit pointer	FFE4		- GET

64 Basic aids x 4

In the February issue of Commodore Computing International, we mentioned that we would be running a series of routines for the 64 that can be used as programming aids. There are four routines this month: Trace, Find, Disk, Catalog. None of these routines' addresses conflicts with each other or with those previously published. The disk and catalog routines assume that the disk unit is unit 8.

Trace:

This routine enables a Basic program line trace facility which prints the Basic line number being run at the current cursor position. Trace is enabled by SYS49409 and disabled by SYS49479.

```
10 T=49409:T=0
20 READA: IFA=-1THEN50
30 POKEI, A: I=I+1
40 T=T+A:GOTO20
50 IFT C 10002THEMPRINT WOLLECKSUM ERROR: "10002, T:
60 PRINT" MOUSE SYS49409 TO ENABLE TRACE"
70 PRINT" WWUSE SYS49479 TO DISARIF"
80 PRINT" IN "END
100 DATA120,169,14,141,8,3,169
110 DATA193,141,9,3,88,96,165
120 DATA157,240,3,76,228,167,165
130 DATA57,201,0,208,9,165,58
140 DATA201,0,208,3,76,228,167
150 DATA165,57,141,24,193,165,58
160 DATA141,30,193,169,91,32,210
170 DATA255,166,57,165,58,32,205
180 DATA189,169,93,32,210,255,169
190 DATA32,32,210,255,76,228,167
200 DATA120,169,228,141,8,3,169
210 DATA167 141,9,3,88,96,-1
```

0 1	C101 C102	78 A90E	SE I LDA	#\$0E	19 20	C129 C12B	A53A 8D1EC1	LUH	\$3A \$011E
2	0104	8D0803	STA	\$0308	21	CIZE	A95B	LDA	#\$5B
3	C107	A9C1	LIA	#\$C1	22	C130	20D2FF	JSR	\$FFD2
4	C109	8D0903	STA	\$0309	23	0133	H639	LDX	\$39
5	C10C	58	CLI		24	C135	A53A	LDA	\$3A
6	CigD	60	RTS		25	0137	20CDBD	JSR	\$BDCD
7	C10E	A59D	LDA	\$9D	26	C13A	A95D	LDA	#\$5D
8	Ciio	F003	BEQ	\$C115	27	.0130	20D2FF	JSR	\$FFD2
9	C112	4CE4A7	JMF	\$A7E4	28	C13F	A920	LDA	#\$20
10	C115	A539	LDA	\$39	29	C141	20D2FF	JSR	\$FFD2
11	C117	C900	CMP	#\$00	30	C144	4CE4A7	JMP	\$A7E4
12	C119	D009	BHE	\$C124	31	C147	78	SEI	
13	CIIB	H53H	LDA	\$3A	32	C148	A9E4	LDA	#\$E4
14	C11D	C900	CMP	#\$00	33	C14A	8D0803	STA	\$0308
15	CiiF	D003	BHE	\$C124	34	C14D	A9A7	LDA	#\$A7
16	C121	4CE4A7	JMP	\$A7E4	35	C14F	8D0903	STA	\$0309
17	C124	A539	LDA	\$39	36	C152	58	CLI	
18	C126	8D18C1	STA	\$C118	37	C153	60	RIS	+

```
10 I=49772:T=0
20 READA: IFA=-1THEN50
30 POKEI, A: I=I+1
   T=T+A:GOTO20
50 IFT<>22816THENPRINT"WOCHECKSUM ERROR: "22816, T:END
60 PRINT"MOUSE SYS49772 TO READ DISK ERROR"
70 PRINT"XXXUSE SYS49772"CHR$(34)"XX"CHR$(34)" TO SEND DISK COMMAND"
80 PRINT"M" : END
100 DATA32,121,0,240,3,76,226
                                                        Disk:
110 DATA194,169,0,133,183,32,176
                                                          This routine is the major part of a dos
120 DATA194,169,13,32,210,255,169
                                                        (disk operating system) aid, it allows the
130 DATA18,32,210,255,162,15,32
                                                        user to send dos commands without the
140 DATA198,255,32,207,255,72,165
                                                        OPEN 1,8,15 on the beginning.
150 DATA144,208,7,104,32,210,255
                                                        An example of this is:
                                                        SYS49772"I" will replace:
160 DATA76,138,194,104,169,15,133
                                                        OPEN15,8,15,"I"
170 DATA73,32,204,225,169,146,32
                                                          It is obvious that there is not a lot of
180 DATA210,255,169,13,32,210,255
                                                        saving of typing but when the complete
190 DATA169,0,76,198,255,32,201
                                                        Basic aid is published, the sys calls will
200 DATA194,141,155,194,141,234,194
                                                        be given Basic command names e.g.
210 DATA141,134,194,133,184,169,15
                                                        SYS49772 will be replaced with DISK.
                                                          The other use of this sys call is to
220 DATA133,185,169,8,133,186,76
                                                        return a disk error message. By just
230 DATA193,225,169,15,166,152,224
                                                        typing SYS49772 the disk error channel
240 DATA0,240,16,221,88,2,208
                                                        will be read and displayed in reverse on
250 DATA6,56,233,1,76,203,194
                                                        the screen. Again when the completed
260 DATA202,240,2,208,240,96,201
                                                        basic aid is published, just DISK.
270 DATA34,240,3,76,8,175,169
280 DATA15,133,73,32,204,225,32
290 DATA115,0,165,122,133,187,165
300 DATA123,133,188,162,6,32,99
310 DATA194,240,11,201,34,240,7
320 DATA232,32,93,194,76,0,195
330 DATA134,183,32,176,194,169,13
340 DATA32,210,255,76,116,164,-1
            207900
                                               0290
 O
     0260
                        JSR
                               $0079
                                          21
                                                       8549
                                                                         $49
                                                                   STA
     C26F
            F003
                        BEQ
                              $C274
                                               C29E
                                                       20CCE1
                                           22
                                                                   JSR.
                                                                         $E160
 0403
     0271
                              #C2E2
           -4GE2C2
                        JMF
                                           23
                                               C2A1
                                                       H992
                                                                         #$92
                                                                   LIH
     0274
                                           24
            A900
                        LIA
                              井生四日
                                               C2H3
                                                       20D2FF
                                                                   JSE
                                                                         $FFD2
 4
                        STA
                                           25
    0276
            85B7
                              $B7
                                               C2A6
                                                       H901
                                                                   LIM
                                                                         #$@D
 T
     0278
            20B0C2
                        JSR
                              $C2B0
                                           25
                                               C2H8
                                                       20112FF
                                                                   JSR.
                                                                         $FFD2
• 5
    C27B
            A90D
                         LIH
                              ##90
                                           27
                                               CZAB
                                                       H900
                                                                   LDH
                                                                         #$00
 7
    CZ7D
            20D2FF
                                          28
                        JSR
                              #FFD2
                                               CZAD
                                                       4CC6FF
                                                                   JMP
                                                                         $FFC6
 8
    0280
            A912
                        LDA
                              #$12
                                           29
                                               C2B0
                                                       200902
                                                                   JSR
                                                                         $0209
 9
    0282
            20D2FF
                        JSE
                              $FF112
                                           30
                                               C2B3
                                                       8D9BC2
                                                                   STA
                                                                         $C29B
10
    0285
            A20F
                        LIX
                                           31
                                               CZBS
                              ##0F
                                                       SDEAC2
                                                                   STA
                                                                         $C2EA
11
    0287
            2006FF
                        JSR
                                           32
                                               C2B9
                              $FF06
                                                       8D86C2
                                                                   STA
                                                                         $C286
12
    C28A
            20CFFF
                        JSR.
                                           33
                                               CEBC
                              *FFCF
                                                       85B8
                                                                   STA
                                                                         $B8
13
    CZSD
                        FHA
                                           34
            48
                                               CZBE
                                                       A90F
                                                                   LDA
                                                                         #$0F
14
    C28E
                                          35
            A590
                        LIA
                              $90
                                               0200
                                                       85B9
                                                                   STA
                                                                         $B9
15
    0290
                                               0202
            1007
                        BHE
                              $C299
                                           36
                                                       A908
                                                                   LDA
                                                                         #$08
16
    0292
            68
                        FLA
                                          37
                                               0204
                                                       85BA
                                                                   STA
                                                                         $BA
    0293
```

17

18

19

0296

0299

20 · C29A

20D2FF

408AC2

68

H90F

JSR.

JMF

FLA

DH

\$FFD2

\$028A

##INF

38

39

40

41

0206

0209

C2CB

CZCD

4001E1

A90F

A698

E000

JMF

LIH

LBX

CPX

\$E101

#\$ØF

#\$00

\$98

423 445 447 899 1 2 3 4 4 5 6 7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	C2CF C2D1 C2D4 C2D6 C2D7 C2D9 C2DC C2DD C2DF C2E1 C2E2 C2E4 C2E6 C2E9 C2EB	F010 DD5802 D006 38 E901 4CCBC2 CA F002 D0F0 60 C922 F003 4C08AF A90F 8549	BEQ BMPECSBPX BESENDER BMPA BMPA BMPA BMPA BMPA BMPA BMPA BMPA	\$C2E1 \$0258,X \$C2DC #\$01 \$C2CB \$C2CB \$C2CD1 #\$22 \$C2E9 \$AFF08 #\$0F \$49 \$E100	59 661 663 64 65 66 67 7 7 2 3 4	C2F3 C2F5 C2F7 C2F9 C2FB C300 C302 C304 C306 C307 C30A C30F C30F C312	A57A 85BB A57B 85BC A200 2063C2 F00B C922 F007 E8 205DC2 4C00C3 86B7 20B0C2 A90D	LDA STA LDA STA LDSR BEQ CMP BEQ INSR JSR JSR LDA TSR	\$78 \$BB \$78 \$EC #\$00 \$C263 \$C30D #\$22 \$C30D \$C300 \$B7 \$C25D \$C25D \$C300 \$EC300
56	C2EB	8549	STA	\$49	73	C312	A90D	LIA	#\$ØD
57	C2ED	20CCE1	JSR	\$E1CC	74	C314	20D2FF	JSR	\$FFD2
58	C2F0	207300	JSR	\$0073	75	C317	4C74A4	JMP	\$A474

```
10 I=49946:T=0
```

Catalog:

The last routine this month is a routine that displays the directory of a disk to the screen. The advantage of this routine over LOAD"\$",8 is that the load loads the directory into memory and then you must list it. This routine will display the directory straight to the screen and not load over your program.

To display a directory, enter SYS49946,0 for drive 0 and all single disk owners and for the lucky ones who have double disk drives connected to their 64's, SYS49946,1 will display the directory on drive 1.

²⁰ READA: IFA=-1THEN50

⁴⁰ T=T+A:GOTO20

⁵⁰ IFT<>29730THENPRINT"XWCHECKSUM ERROR:"29730,T:END

PRINT WAUSE SYS49946,0 FOR DIRECTORY LISTING"

⁷⁰ PRINT" OF DRIVE 0 AND SYS49946,1 FOR DRIVE 1"

⁸⁰ PRINT"WW":END

¹⁰⁰ DATA32,253,174,32,121,0,240

¹¹⁰ DATA11,201,48,240,7,201,49

¹²⁰ DATA240,7,76,8,175,169,48

¹³⁰ DATA208,2,169,49,141,235,195

¹⁴⁰ DATA169,2,162,234,160,195,32

¹⁵⁰ DATA189,255,169,14,32,203,194

¹⁶⁰ DATA162,8,160,0,32,186,255

¹⁷⁰ DATA32,192,255,144,10,72,165

¹⁸⁰ DATA184,32,195,255,104,76,249

¹⁹⁰ DATA224,160,3,132,183,166,184

²⁰⁰ DATA32,198,255,32,207,255,133

²¹⁰ DATA87,32,183,255,208,114,32

²²⁰ DATA207,255,133,88,32,183,255

²³⁰ DATA208,104,164,183,136,208,224

²⁴⁰ DATA132,183,32,207,255,72,32

²⁵⁰ DATA183,255,170,104,224,0,208

²⁶⁰ DATA84,164,183,192,80,176,78

²⁷⁰ DATA153,0,2,170,240,4,230

²⁸⁰ DATA183,208,227,32,204,255,166

²⁹⁰ DATA159,224,3,240,5,166,158

³⁰⁰ DATA32,201,255,166,87,165,88

³¹⁰ DATA32,205,189,169,32,32,210

³⁴⁰ DATA169,13,32,210,255,32,20**4**

350 DATA255,32,225,255,240,16,32 360 DATA228,255,201,32,208,5,32 370 DATA228,255,240,251,160,2,208 380 DATA155,32,204,255,165,184,32 390 DATA195,255,76,123,227,36,48,-1

0-20456700000000000000000000000000000000000	C31D C31D C3224 C3224 C3224 C3224 C3224 C3222 C322 C3222 C3222 C3222 C3222 C3222 C3222 C3222 C3222 C3222 C3222 C32	20FDAE 207900 F008 C930 F007 C931 F008 F008 F008 F008 F008 F008 F008 F00	SHE JSR STA JSR BNE LDY DEY BNE STY JSR	\$403333152A3DBC080BC5 \$403333152A3DBC080BC5 \$403333152A3DBC080BC5 \$40333352A3DBC080BC5 \$40333552A3DBC080BC5 \$40333552A3DBC080BC5 \$40333552A3DBC080BC5 \$4033555555 \$403355555 \$40335555 \$4033555 \$4033555 \$403355 \$403355 \$403355 \$403355 \$403355 \$4035 \$4035 \$40355 \$4035 \$40355 \$40355 \$40355 \$40355 \$40355 \$4035 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40355 \$40	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	556798BDF14579BE02469BDG257ACCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC	AA 68 00 0 1 4 7 6 8 8 9 0 0 5 4 8 9 0 0 5 4 8 9 0 0 0 5 4 8 9 0 0 0 0 5 4 8 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AMOCUERXXXAXARARYAGGRYEARRARPERQYERARRARPIN LCBLISDARARYAGGRYEARRARPERQYERARRARPIN LJJSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS	##CB7000 B #FC 39 9 FC 4 #FFFFBD23CD BD2C1F4 B45CFC 39 9 FC 39 FF55B2F623CD BD2C1F4 B45CFC 3BF3CC 3FBF55B2F623CD BD2C1F4 B45CFC 3BF55BF55BF55BF55BF55BF55BF55BF55BF55BF5
45 45	C381 C382	48 20B7FF	FHA	\$FFB7	92	CBER	2430	BIT	\$30

VIZASTAR 64

THE INFORMATION PROCESSOR

One word menu lines for easy selection of facilities

■ The high resolution grid pattern frames the worksheet giving an easy-to read display.

Spreadsheet

Database

Graphics

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■ Parallel printers require ONLY a low-cost cable.

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■ Text editing facilities for letters, invoices, report headings etc.

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SOFTWARE

E RURILLE CO LITE VIEW

```
10 I=49492:T=0
20 READA: IFA = - 1 THEN 50
30 POKEI, A: I=I+1
40 T=T+A:GOTO20
50
   IFT (>32027THENPRINT" XXXCHECKSUM ERROR: "32027, T:END
60 PRINT" MANUSE SYS49492./STRING/ TO FIND STRING"
70 PRINT"MM": END
100 DATA32,253,174,32,99,194,133
110 DATA89,162,0,32,127,193,32
120 DATA157,193,120,169,23,141,0
                                                          Find:
130 DATA3,169,194,141,1,3,88
                                                           This routine will find any and all
140 DATA32,171,193,32,24,194,32
                                                         occurrences of a string or command in a
150 DATA177,193,76,115,193,76,8
                                                         Basic program. When the comparison
160 DATA175,32,93,194,246,248,197
                                                         has been found, the line on which it was
                                                         found will be listed to the screen and it
170 DATA89,240,13,157,128,191,232
                                                         will search for the next occurrence.
180 DATA224,64,208,239,162,23,76
                                                           To call the Find routine, use
190 DATA55, 164, 169, 0, 157, 128, 191
                                                         SYS49492,dstringd. This will find all
200 DATA134,34,96,165,43,24,105
                                                         occurrences of string in the program, d is
210 DATA2,133,87,165,44,105,0
                                                         a delimiter character that marks the start
                                                         and the end of the find string. This can be
220 DATA133,88,96,162,0,160,2
                                                         any character that is not in the string. The
230 DATA132,35,165,1,41,254,133
                                                         usual character to use is '/' but if the
240 DATA1,177,87,221,128,191,8
                                                         string 'PRINT' was to be found instead of
250 DATA165,1,9,1,133,1,40
                                                         the command, use the "character as d.
260 DATA208,7,200,232,228,34,208
270 DATA229,96,230,35,164,35,162
290 DATA0,177,87,240,3,76,177
290 DATA193,165,87,56,233,2,133
300 DATA87,165,88,233,0,133,88
                                          400 DATA141,106,194,165,88,141,107
310 DATA160,0,177,87,133,89,200
                                          410 DATA194,169,145,32,210,255,177
320 DATA177,87,133,88,5,89,240
                                          420 DATA87,133,20,200,177,87,133
330 DATA16,165,89,24,105,2,133
                                          430 DATA21,32,19,166,32,201,166
340 DATA87,165,88,105,0,133,98
                                          440 DATA173,104,194,133,34,173,105
                                          450 DATA194,133,35,173,106,194,133
350 DATA76,171,193,104,104,32,93
360 DATA194,120,169,139,141,0,3
                                          460 DATA87,173,107,194,133,88,230
370 DATA169,227,141,1,3,88,96
                                          470 DATA35,164,35,162,0,96,230
380 DATA160,0,165,34,141,104,194
                                          480 DATA122,208,2,230,123,160,0
390 DATA165,35,141,105,194,165,87
                                          490 DATA177,122,96,0.0,0,0,-1
                                               0175
                                                       20B1C1
                                           14
                                                                        $C1B1
                                                                   JSR
       0154
              20FDAE
   9
                          JSR
                                $HEFI
                                           15
                                               0179
                                                       407301
                                                                   JMF
                                                                        $C173
       0157
              206302
                          JSR
                                $0263
                                           15
                                               C17C
                                                       4CØ8AF
                                                                   JMF
                                                                        $AF08
       C15A
              8559
                          STA
                                $59
                                           17
                                               C17F
                                                       205DC2
                                                                   JSR.
                                                                        $C25D
   3
       0150
              H200
                          LIX
                                #$00 '
                                           18
                                               0182
                                                      F@F8
                                                                  BEQ
                                                                        $C17C
   45
       C15E
              207FC1
                          JSR
                                $017F
                                           19
                                               0184
                                                      0559
                                                                  CMF
                                                                        $59
       0161
              209DC1
                          JSR
                                $019D
                                           20
                                               0186
                                                      FARTI
                                                                  BEQ
                                                                        $0195
   5
       0164
              78
                          SEI
                                          21
                                               0188
                                                      9DSGBF
                                                                  STA
                                                                        $BF80.X
       C165
              A917
                          LDA
                                #$17
                                          C18B
                                                      E8
                                                                  INX
       0167
              8D0003
                          STA
                                $0300
                                          23
                                               C18C
                                                      E040
                                                                  CPX
                                                                        #$40
   7
       C16A
              A902
                          LDA
                                ##02
                                          24
                                               018E
                                                      DOEF
                                                                        $C17F
                                                                  BHE
  10
       0160
              8D0103
                          STA
                                $9391
                                          25
                                               0190
                                                      A217
                                                                  LDX
                                                                        #$17
  11
       C16F
              58
                          CLI
                                          26
                                               0192
                                                      4037A4
                                                                  JMF
                                                                        $A437
  12
       0170
              20ABC1
                          JSR
                                $CIAB
                                          27
                                               0195
                                                      A900
                                                                  LDA
                                                                        #$00
  13
       0173
              201802
                          JSR
                                $C218
```

28

0197

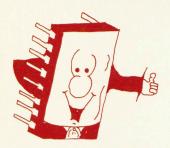
9D8ØBF

\$BF80.X

STA

29 C19A 30 C19D 31 C19B 32 C1AA 33 C1AA 34 C1AA 35 C1AA 36 C1AB 37 C1AB 38 C1AB 40 C1AB 41 C1BB 42 C1BB 43 C1BB 44 C1BB 45 C1BB 46 C1BB 47 C1BB 48 C1BB 50 C1CA 51 C1CA 52 C1CA 53 C1CA 54 C1DB 56 C1DB 67 C1DB 68 C1BB 69 C1BB 70 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 79 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB 76 C1EB 77 C1EB 78 C1EB 79 C1EB 70 C1EB 71 C1EB 72 C1EB 73 C1EB 74 C1EB 75 C1EB	60 A52B 18 6902 8557 A52C 6900 8558 60 A200 8423 A501 B157 DD801 8501	SRICASLASKYYAADAAAAAAAAXXXXXXXXXXXXXXXXXXXXXXXXXX		834 854 854 855 867 889 999 999 990 100 100 100 100 10	C1FD C1FF C203 C206 C207 C208 C207 C218 C217 C218 C217 C217 C217 C217 C217 C2217 C222 C222	A558 6900 8558 4CABC1 68 68 205DC2 78 A98B 8D0003 A9E3 8D0103 58 60 A000 A522 8D68C2 A523 8D68C2 A557 8D6AC2 A558 8D6BC2 A991 20D2FF B157 8514 C8 B157 8515 2013A6 20C9A6 AD68C2 8523 AD69C2 8523 AD69C2 8526 AD69C2 8527 AD6BC2 8528 AD69C2 8529 AD69C2	JSR LDA STA LDA STA LDA STA	\$58 #\$80 \$51AB \$C1AB \$C25D #\$80 \$63301 \$6330
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VIC 20 GAMES AND UTILITIES

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Accuracy and speed are required for this shooting gallery, superb use of colour and graphics in this new and challenging game from the author of "JACKPOT", 100% machine code program, to the same high standard, joystick or keyboard control. For the unexpanded VIC......£5.50

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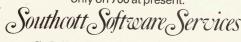
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HARD DISK INTERFACE

HARDBOX is the intelligent controller that lets you add a Corvus hard disk drive to your Commodore computer. In fact, you can chain up to 4 hard disk drives of 6, 11 or 20 Megabyte capacities.

Compatible with CBM DOS versions 1 and 2, the HARDBOX operates with existing Commodore programs and appears to the Commodore as a high speed, high capacity floppy drive.

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Create a multi-user network by adding the Corvus Constellation multiplexer to your hard disk system. With a HARDBOX at each work station, up to 64 users can simultaneously access the same drive.

As a multi-user system, the HARDBOX provides:

- Separate user areas on each hard disk.
- Multi-user work areas for shared programs.
- File and record locking for shared databases.
- Password protection of user areas.
- Access to any user area from any station using the password.

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The HARDBOX supports the Corvus *Mirror Option*. This provides a high-speed, low cost means of backup, using a commercial video cassette recorder. Backup speeds of 7½ kilobytes per second let you save contents of a 10 MByte drive in less than 20 minutes. Video cassette capacity is approximately 100 Megabytes.

Hardware Requirements

- Commodore 3000, 4000, or 8000 series computer with BASIC 2 or 4.
- One HARDBOX and PET-IEEE cable per work station.
- Corvus bare drive and ribbon cable.
- Access to a floppy disk or cassette.

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BUSINESS PRODUCTS

ISG expand service

To cope with a growing demand for the after-sales servicing of computers and related products, ISG Data Sales have expanded their technical services and maintenance departments. Centres have opened in Manchester and Birmingham.

ISG currently provide an independent 24 hour service for Commodore micros as well as a range of printers, terminals and disk drives. Emergency call outs and contract service work are dealt with.

Contact: ISG Data Sales, Wellington Industrial Estate, Basingstoke Road, Spencers Wood, READING RG7 1AW. Tel: 0734 884666.



3D's industrial interface

Digital Design and Development (3D) have introduced the GPIS (General Purpose Interface System), an interface designed specifically for low budget industrial applications. It retails at £700 + VAT.

It offers a combination of

analogue inputs and outputs with 12 bit resolution. In addition there is an 8 bit port for digital inputs and one that provides an open collector Darlington stage. The system is self-contained with integral power supplies, connectors,

indicators and a ribbon connector to the CBM 64 memory expansion port.

Contact: 3D Digital Design and Development, 18/19 Warren Street, LONDON W1P 5DB. Tel: 387 7388.

Qume graphics terminal

The QVT 211 GX, a Qume terminal from ISG Data Sales combines graphics capabilities with normal business computing features. It retails at £950.

On the adjustable 14 inch screen, the QVT 211 can display the separate and independent graphics memory at the same time as its alphanumeric memory. It has its own built-in graphics mode plus a menu set up mode instead of Dip switches.

Contact: ISG Data Sales Ltd, Wellington Industrial Estate, Basingstoke Road, Spencers Wood, READING, RG7 1AW. Tel: 0734 884666.

Legal system

Cortex Computer Systems have just introduced Lawcomm, a system suitable for use in a small practice. It enables solicitors to extract information from the Eurolex legal database.

The complete configuration, designed for the 8000 series, costs under £4000 and includes 2 MB disks, daisy wheel printer, modem and the communication software. Other functions include word processing, budgeting, time recording and accounting software can be used on the

Contact: Cortex Computer Systems Ltd, Cortex House, 5 Union Street, BEDFORD. Tel: 0234 217721/2.

Modular mate

A modular version of their accounting system. The sysofficeMate Accounting software has been developed by the Micro Computer Centre. The modules vary in price, but the full system costs £1700.

The Modules include the Cash Book, Sales Book, Purchase Ledger, Nominal Ledger, and a Payroll. Altogether there are 382 different modules. Each of these can be bought individually or linked to provide a totally integrated

tem can be tailored to fit the customers needs.

Only one working disk is needed as all the modules can be incorporated onto the original disk. The software is menu driven and includes a main menu and the appropriate sub-menus.

Contact: Micro Computer Centre, 28 Sheen Lane, LON-DON SW14. Tel: 878 7044/5/6/7.

Free brochures

The Computer Supplies Company are giving out free colour brochures on fire proof safes, cabinets and computer acces-

Floppy disks and magnetic tapes are becoming increasingly popular as the media on which important

business information is stored, but fire is a threat and years of work could be wiped out in minutes.

Contact: Unit 23 Henlow Industrial Estate, HENLOW, Bedfordshire, SG16 6DS. Tel: 642 813511.

BUSINESS PRODUCTS

Sales training course for dealers

Systemate Ltd have launched a sales training course, specifically for computer dealers. Starting on a Friday morning, the delegates are taken through three intensive days, finishing on Sunday evening.

The course price of £250 per person includes meals and

accommodation. Wives (or husbands) and children are accommodated free of charge and the courses are held in the most convenient Holiday Inn for all the participants.

The basic selling skills are ·taught along with role playing exercises. Emphasis is laid on the pre-approach work and after sales service. Professional presentation and customer relations are also discussed.

Contact: Systemate Ltd. 77 Laleham Road, STAINES, Middlesex. Tel: 0784 62588.

Long distance driver

Data transmitted over distances of more than 30m tends to corrupt or deteriorate in quality, so Inmac developed the Datadriver which could solve the problem. Two versions are available; a pair powered from the mains, retailing at £349 and a self contained pair powered from pins 9 and 10 of the computer at £289.

One datadriver is plugged into the RS232 socket and the other is attached to the peripheral. A thin flexible cable links the two. The peripherals can be located up to a mile

Contact: Inmac (UK) Ltd, Davy Road, Astmoor, RUN-CORN, Cheshire, WA7 1QF. Tel: 09285 67551.

Monitor

Microvitec's new Universal Monitor was launched recently. It is a colour monitor compatible with other equipment and capable of accepting inputs in different signal formats.

The Colour Monitor accepts RGB and PAL-encoded signals direct from the CBM 64 so that it can produce quality pictures and sound from a camera or videorecorder. Two screen sizes are available - the 14 inch model with the audio facility retailing at £259 + VAT and the 20 inch model with three power inputs at £385 + VAT.

Contact: Microvitec Ltd, Futures Way, Bolling Road, BRADFORD, BD4 7TU, West Yorkshire, Tel: 0274 390011.

Consult

Zebra Computer Services have set up a Computer Consultancy with full technical maintenance services to serve the East Midlands and East Anglia.

Zebra

Large and small companies are dealt with and Commodore compatible hardware and software is supplied.

Contact: Zebra Computer Services Ltd, 9-10 St George Street, STAMFORD, Lincolnshire PE9 1BT. Tel: 0780 54695.

New modems from Scicon

Scicon Ltd have introduced of information networks two new Modems, expanding their range of data communication products; the V21 Buzzbox retailing at £70 + VAT and the four function 2123 GT at £498 + VAT.

The Buzzbox operates at a speed of 300 bps and enables Commodore users to communicate with other computers and to access into a range

Viewdata, Electronic Mail for instance.

The 2123GT, a more sophisticated model operates at speeds of up to 9600 bps and has a number of facilities including error correction and auto dial.

Contact: Scicon Ltd. Tel: 01 580 5599.

Worker for hire

A service providing specialist workers for the data processing industry has been started by Tangent.

Systems analysts, programmers, project managers and business analysts can be hired for use on projects or as temporary replacements for absent staff. In addition they will provide a project team to help clients augment a Data processing system.

Contact: Tangent Computer Services Ltd, Fairfield House, Fairfield Road, BRENT-WOOD, Essex CM14 4LR. Tel: 0277 255755.

Paper handlers

Swingline, an American Company have produced four paper handling devices specifically for data processing; an upright and Table Top model for both the Decollator and the Burster.

The size, weight and length

of the sheets that the equipment can handle varies for each model.

Contact: Swingline, 32-00 Skillman Avenue, Long Island City, N.Y. Tel: 11101/212 729

Mator dolphin for a PET

Mator Systems have added the Dolphin 3 to their range of Protocol Converter Systems.

The equipment, costing under £1000, enables users to link PET micros with IBM mainframes using 3780 and 2780 protocols. The unit also provides a simple plug-in IEEE 488 connection to the PET.

Contact: Mator Systems Ltd, 134-140 Church Road, HOVE, Sussex. Tel: 0273 720451/2.

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In America, Practicalc has swept to the top of the software charts. Commodore User Magazine described it as "storming American Vics as the greatest spreadsheet since Visicalc."

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Line spacing: 6 lines per inch

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240 volts, 50Hz
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Dimensions: (H) 6.4" (W) 19.5" (D) 12.4" Weight: 18.5 lbs

Operator Controls: Power on/off, top

of form, impression

controls (5 levels)

INTERFACES

Parallel Contropies

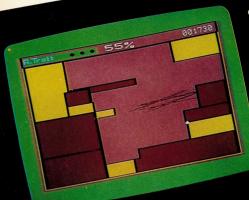
Centronics compatible, 7 bit parallel data, 3 control lines (data, strobe, busy, acknowledge)

Serial RS232C compatible, 50-19200 BPS, parity and character bit length all

Dataplus-PSI Ltd 39-49 Roman Road Cheltenham GL51 8QQ. Reg. No. 1715271 England. Offer open to UK only while stocks last.

1	ATAPLUS-PSI Ltd 39-49 se send me:—	Roman	Road Ch	neltenha	ım G	L51	8Q	Q							
Qty	Description	Price	Total	l enclo	ade	paya	able	e to	DAT	AP	LUS	S-F	PSIL		d
	TP1(s) with RS232 interface	£250		Accou		ge my Access/Barclaycard* nt No.									
	TP1 with centronic interface	£250		Expiry	date	e of	ca	rd_	1					_	1
	CBM 64 interface and cable kit	£39		Signat	ure .										
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for programmers



MIKRO is a full 6502/6510 ASSEMBLER with the power that professional programmers need, yet so simple to use that we recommend it to beginners! The MIKRO cartridge has many other facilities including editing commands and a machine language monitor, all for £57.50.

-c16,d2

There's much more for the 64 in the SUPERSOFT catalogue. Ask your computer dealer for a copy, or phone 01-861 1166.

The Best & Software

BUSINESS SOFTWARE

STORR your accounts

This month we look at two accounting packages: Storr from TM Software Systems and the Integrated Accounts System LB13 from Electronic Aids, Both operate on the 8032 with an 8050 disk drive, although the Integrated Accounts System will also run on the 8096, with a version for the 700 under development. Both have similar features (and similar drawbacks), the main difference being in price. The Electronics Aids package at £400 plus VAT, costs £350 less than TM Software' package despite having extra facilities.

STORR

STORR is the stock control and accounting system for the 8032 developed by TM Software, whose business philosophy is 'seeing is believing'.

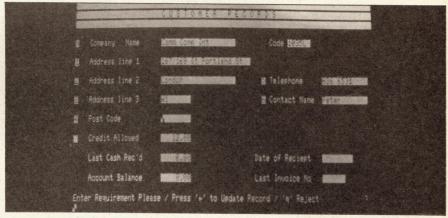
Hardware requirements are an 8032 with an 8050 disk drive and a Commodore printer. The program was written for the 8024 printer, but by changing the secondary address to seven it should be possible to use the 8023 or 8026.

Computer jargon is thankfully lacking in the manual which accompanies STORR, making it ideal for businessmen who want a quick and easy introduction to office automation.

After plugging in the dongle and loading the two disks (one containing the program, the other a demonstration disk), the first step is to enter the current date. This is simple, but it would be helpful if the cursor jumped from one input area to another rather than having to put a comma between each set of figures. However, this is the only area in the program that requires punctuation. One unnerving feature of STORR, which is common to many accounts packages, is that between the entry of the date and the screening of the main menu the screen blanks out for a seemingly long period.

There are 15 options to choose from on the main menu and, as with most systems, it is best to go through the program 'chronologically. If the user goes straight into some parts of the system, he will not be able to get any further due to a lack of information.

The first option on the main menu contains the system parameters, most of which are user amendable. Bypassing this option, the first major step is to create all the business records the



format for which is provided on the demonstration disk. The records are protected by programmer-defined security which can be overriden by the master password.

Errors made before data is saved onto disk are not easily amended. As the cursor can not be moved around the screen at the will of the user, the prefix of the line must be entered before any corrections can be made.

As this is an integrated system with data being updated as trading progresses, not all of the display is ammendable. However, this part of the system is not free from errors. In the supplier records section of this program an error in the screen layout has resulted in two locations being labelled 'number seven' - telephone numbers and credit. This means that data entered as a telephone number enters the location allocated for the amount of credit which could lead to all kinds of problems!

Once saved onto disk, data can be updated by entering the relevant account number and calling up an account.

A discount structure provides four separate price levels. Stock records also show the actual location of stock in the warehouse and the amount of VAT per item. VAT is one of the user-defined parameters in the system, which has four available VAT codes.

The number of records which can be catered for by STORR is limited by the size of the disk. However, any number of disks can be used depending on the nature and size of the business. Typical storage would be 2000 stock accounts. 500 sales accounts, purchase accounts. invoices, cash received and paid entries, and delivery blocks.

Product: Accountancy package; Price: £750 plus VAT;

Documentation: Jargon-free manual:

Applications: Business;

Capabilities: VAT, stock control, credit control:

Minimum hardware: CBM 8032, 8050 disk drives, 8023/24/25 printer;

Company: TM Software, Address: 105 Uxbridge Road, Hanworth, Middx. TW135EH. Tel: 01-7550713

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BUSINESS SOFTWARE

INTEGRATED **ACCOUNTS** SYSTEM LB13

Emphasis on data security is one of the major advantages that Electronic Aid's Integrated Accounts System LB13 has over similar packages. In addition to a dongle which contains all of the security, it is impossible to enter the system without the correct password. And even when the user is into the main system, there are several other passwords needed before the user can enter the different sections provided by the main menu. These passwords are written and stored in code at a secret location on the disk.

Once the program has been loaded the user encounters the same problem seen in this stage of the STORR package. That is the screen is left blank for a short period and the user wonders if anything is happening.

With the disk formatted, the user has to set up the reports, invoices and ledgers, then decide on the number of accounts required before any data can be entered into the system. In this respect the program is quite large and it is possible to put 600 customer or supplier records onto one 8050 disk with a maximum of 40 invoices per record.

Again the first data to be entered is the date followed by the accounting period. The built-in calender facility displays the correct day on screen as a final check to ensure that the date entered is correct.

The next step is to set-up the invoices and ledgers. The ledger system is simply a series of records of transactions relating to the financial affairs of the business. With purchase ledgers, transactions are related to the name of the supplier, whereas with the nominal ledger all transactions are analysed between accounts where the name matches that of the transaction.

The nominal ledger includes records of money which has been borrowed or loaned and the sales ledger records invoices between the company and the customer. Because of the double entry principle operated by the ledger system, totals of unpaid purchases and sales should equal those of the opening balances on the other ledgers.

Fixed costs such as overheads, profit and loss are pre-set reports in the nominal ledger. On loading the nominal ledger program, the user gains immediate access to ledger reports enabling him to examine the audit trail, print the balances and access the cash book and nominal journals.

Customer records can be updated in each of the three ledgers and lists of records can be printed out.

Keeping track of current stock levels is catered for to a certain extent, but the stock control routine is not completely integrated with the rest of the package due to lack of memory. Instead, it is accessed direct from the main menu. (In order to make this routine fully integrated the user would have to sacrifice a number of nominal accounts and possibly encounter a reduction in the operating speed of the system. Therefore Electronic Aids recommend that the 700 version should be used if full integration is required.)

The stock record can be amended at this stage. When data is being amended the cursor appears at the bottom of the screen and the line number has to be entered before amendments can be made. Payroll is another area of business financial management which cannot be ignored which is incorporated in this accounting package. This routine includes all the features generally found in a payroll program. It does not, however, have any facility to erase employee records should an employee leave before the end of a tax year. The user must wait until the end of the tax year and then mark the files as vacant so that it can be used for further employees.

Another interesting section of this program is the utilities option which appears on the main menu. This option is selected when a new disk is being formatted or a backup copy is being made. Directories can be viewed on screen or printer (any Commodore printer should suffice) and the same applies to the other files.

Product: Business accounting;

Price: £400 plus VAT;

Documentation; Good manual; Applications: Business Management: Hardware requirements: CBM 8032, 8096 or 700 with 8050 or 8250 disk drive and any Commodore printer;

Company: Electronic Aids, Address: Mythe Crescent, The Mythe, Tewkesbury, Gloucestershire GL20 6EB. Tel: 0386 831020.

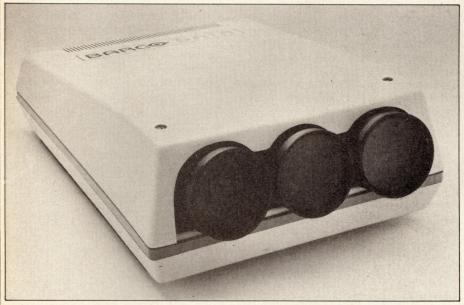
Stock control -----

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Record
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                   Stock ref. no. ABCDEF
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BUSINESS HARDWARE

Business projections

This month we look at two very different products for the business market. The GPIS from 3D is a useful tool for anyone who wants to feed normally unacceptable signals into a computer while the Powerhouse projection systems enable a huge display of the information that appears on the monitor screen.



Powerhouse Enterprises have designed a video projection system for use in business. Used with a wide range of computers, including the Vic 20 and 64. The Barco Data Projector and PCP 1000 system allow the office user to produce more efficient business presentations to prospective clients or other departments. The occasions for application are many and varied.

Accepted input sources range from the Prestel service to video cassette recorders and computers. To give a comprehensive audio/visual presentation from one projection source, multiple sources of information can be combined by using the processing

The external processor on both the b/w Barco Data Projector and the colour PCP100 will produce RGB and composite video signals. Users in the U.K. are assured the standard PAL signal input (which has 625 lines per screen) will be acceptable, as will the NTSC (European and American) and the French system Secam

Taking the composite video signal from the video output on the back of the micro, the video board sorts and decodes the signals before transferring them to the RGB input. Newcomers to the computing industry will find the b/w projector the simplest to set up, there being just one projection CRT compared to three in the colour version. These three CRT tubes are of high resolution and surrounded by a liquid cooling chamber allowing the use of greater

Should a beginner decide upon the colour version he will find, within a short useage period, the setting up operation to be a simple matter. With all projectors

focusing is the most important aspect to be considered.

To gain the best possible effect when making a presentation with one of these machines the designers have set up a test grid consisting of the three spectrum

The lines forming the grid must be matched perfectly to ensure the legibility of the projected presentation.

These projectors are hooked up to the back of a Vic 20 or a CBM 64 via an interface, (which in the case of this review was provided by Small Systems Engineering - many thanks). The interface converts the monitor output from the computer to a standard PAL signal for the projector.

The Barco Data Projector and the PCP 1000 are already used by such companies as IBM, ICL, the Wellcome Foundation, Cancer Research, BP and Shell. These machines could also be used in a teaching environment.

Name: Barco Data Projector

and the PCP 1000. Company: Powerhouse Enterprises, The Old Power

House, Chapel Rise, Avon Castle, Ringwood, Hants BH24 2BL. Tel: 04254 79569/2043.

Product: Video/Computer Projector System.

Applications: Business Conferences, Training Courses and Teaching.

Minimum hardware required: PET, VIC 20 or CBM

Price: PCP 1000: £10.500 + VAT Barco Data Projector; £7,900 +

BUSINESS HARDWARE

From Ato D

The interface reviewed here is the General Purpose Interface system from 3D Digital Design and Development, designed for use with the Commodore 64. It can also be used with the Vic-20, although this requires a different set of interface cables.

3D's General Purpose Interface System is a sophisticated piece of electronics which converts information from analogue signals to digital signals and vice versa. Until the advent of computers such conversions were hardly ever necessary, but since computers can really only understand numbers it is essential that any information to be fed into the computer is digital.

This particular interface system has been put to some interesting applications. One of 3D's OEM customers is using the General Purpose Interface System at the heart of an automatic fermentation rig, the idea being to carry out work in bio-genetics. The company experiments with different strains of fermentation germs under different conditions and monitors their growth, It has to have the ability to monitor and control both analogue and digital signals and this is where the interface system comes in.

The system is also used by the engineering department at Oxford University, and 3D says that its General Purpose Interface System is appropriate in any production or laboratory conditions where it is necessary to monitor and control both analogue and digital signals.

This interface occupies eight memory locations which are divided into memory-read and memory-write, with the three lower bits of the address lines providing the memory address.

It is hooked-up to the 64 via two 25 way d-type ribbon connectors which plug into the memory expansion port, one connector for digital input and the other for digital output. Input can be provided either by eight analogue differential inputs or 16 analogue channel inputs. These signals can be bi-polar or uni-polar. The General Purpose Interface System can, of course, convert signals both ways - digital to analogue and analogue to digital.



With the analogue to digital converter there are just two configurations. The first of these is the convertor reference voltage. Voltage to this convertor is controlled by a multi-channel potentiometer (pot) which acts as a sensitivity control. Once it has been calibrated, it is possible to set 10 conversions per second without using the on-board oscillator on the convertor. When the oscillator is used, the speed can be increased to as much as 30 conversions per second.

When digital information is being converted to analogue data, the output voltage is switch selectable from a range of 0-10 volts. Each convertor associated with the five switches has three pots which perform various functions. Two of these set the value sent to the convertor as 4095 (which provides full scale output) and 0 (whichprovides minimum output). The inclusion of the third function on the unit will, however, eliminate the voltage scale specified on the original unit as it enables the maximum output value to be exceeded.

The two convertors in the interface can be programmed using BASIC, 6502 or 6501 Machine Code. All the user has to do is to Peek and Poke the specified memory locations. However, because all the analogue signals pass through a multi-plexer before reaching the conver-

tor the required channel must be selected before the data can reach the convertor.

Three data lines leading from the micro are used for channel selection. while a fourth is used to select which of the convertors will supply the data to the micro.

The front panel of the unit houses the eight analogue input channels, each of which has a five-way switch to select the output voltage. Each channel is capable of handling 50 volts and 400 mega amps so it is possible that the system could be used to drive motors.

In addition to the analogue input channels, there are eight digital input channels that allow the user to monitor eight digital inputs.

A comprehensive manual accompanies the General Purpose Interface System, giving a full description of the configuration of the system and the necessary connections to the micro. There are also several sample programs showing how to send analogue and digital signals.

The unit, which also runs on the BBC and Apple, has not been officially tested by Commodore, but has been rigorously tested by customers of 3D. In conclusion, 3D's General Purpose Interface System is a very useful piece of equipment for specialist applications.

PRODUCT SURVEY

8000 ways to get your

Many software companies are now producing accounts packages to enable hours of work by hand to be accomplished in minutes by a relatively inexperienced operator. In this month's product survey we take a look at a selection of accounts packages available for the 8000 series. concentrating on the payroll element. First we take a general look at the facilities provided by a payroll program. Then we focus on some of the available software.

Speed and accuracy are the main benefits of letting a computer run your payroll. The average time needed to enter details for each employee during a payroll run is just 12 seconds, the computer does the rest. Mistakes are completely eliminated as, given the correct data, a computer will always get its sums right and never looks up the wrong code number, week number or tax table. Another benefit is that a computer can provide useful statistics such as the cost of labour, hours worked, and monthly or end of year analyses.

When choosing the payroll program most suited to your business, one of the first considerations to be made is the choice of format. Programs are available on cassettes, floppy disks and hard disks. Unless you are prepared to invest in more hardware, your choice must be limited to software developed especially for your existing system.

Requirements for a payroll program will vary for different businesses, but the fundamental requirements are the same. Any payroll program should be flexible enough to accommodate differences in basic pay, tax, overtime and other variables. Statutory Sick Pay is now a legal necessity so SSP calculations are another essential feature.

Most payroll programs allow hourly, weekly and monthly paid staff to be mixed on to the same disk in any order. Overtime rates are generally set by the user, with some packages catering for anything up to 11 different rates.

The treatment of Statutory Sick Pay varies slightly but in general a payroll program will calculate the amount due to be paid and automatically compute and insert the correct amount on the payslip. Some incorporate a 'help' section which leads the user through SSP legislation as set out in the Employer's Guide to SSP. The SSP paid total is held and overall totals for the year to date are provided.

When tax codes change, the user just enters the changes for each code and then the computer automatically amends each employee's tax code. Changes in tax rates however, aren't quite as simple. Any change in legislation will require either an updated disk or a program which updates the payroll disk. (Check the service provided with individual packages).

A choice of payroll run method is offered by some programs. For example, payslip printed out after each entry: all entries made first, then continuous print run; immediate payslip run without entries; or a selection of individual employees. Payslip stationery varies with options of plain or pre-printed payslips, and pre-perforated sheets. Some packages allow you to design your own print formats. Payslips and copies are generally produced side by side so that employers' copies can be kept in a continuous strip for conveni-

To allow for the fact that a computer may suddenly be required for another use, some programs incorporate an interrupt system whereby in the middle of entering pay run information the whole system can be closed down at the

touch of a key. On re-running the Pay Run program it will automatically go back to the point of the close down so that entering can continue.

For cash payments, programs can offer coin analyses indicating the required notes and coins for pay packets. Others automatically print Giro slips or cheques for employees that have been designated to be paid in that manner.

All payroll programs offer several analyses ranging from an analysis after each pay run and such liabilities as tax, National Insurance and refund of SSP at the end of each month, to a summary of the whole year's operation together with all forms required for annual returns printed automatically.

Any necessary amendments to data (change of name, bank details, rate of pay, etc.) can easily be made by those with access to the system. In the event of an employee leaving, some programs allow the user to delete the employee from the system, displaying P45 details. Others have no routine for deleting an employee until the end of the tax year. Files of employees who have left can then be re-used for a new employee.

While there is a limit to the capacity of each data disk, many systems allow the analyses from disks to be combined making the system capacity almost

Payroll packages can also cater for businesses with more than one company, all running separate payrolls. A company's name and details of how the payroll is to operate are kept on the payroll data disk, and not with the

PRODUCT SURVEY

payroll sums right

	Tax Wk/Mth.		Date	Dept	Number	Company			-	
	Week 21	26	Aug 83			Com	outastore Li	mited		
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	GROSS PAY EL	EMENT!	S:			STANDARD I	DEDUCTIONS:			
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182,	O/Time 1 @	2.67	2.5		6.68	National	Insurance			-12.62
1.5	D/Time 2 @	3.50			0.00	Tax				-28.50
197	D/Time 3 @	4.00	6		24.00	AFTER TAX	ADJUSTMENTS	:		1
3	Bonus A				12.00	Union A				-0.15
tore	Bonus B				2.30	Overalls				-0.20
rutas	Shift				2.00	Savings	,			-5.00
TE O	Attend @	1.00	4		4.00	Mileage	@ .17	22		3.74
J. T.	Supervisor				5.00					4.54
pyric	Piece Wk @	. 15	41		6.15	NET PAY		(1)		94.98
8	Sick Pay (S	SP)	1 Day	/5	8.05					A/pay
	133.17γ	212	25.82	396.6	50	198 H	28.67	AB 21	34 52	
1	Taxable Gross	Gross to	Date	Tax to	Date	Tax Code	Total NI		NI Number	

A computerised payslip produced by Computastore's SuperPay payroll program.

program. This means that each company's details can be set up along with the employees' data and run using the same program.

Operation of a payroll program is always easy, but this does not mean that records can easily be tampered with. Access to data is only possible with a security password or code which can be changed when required. As a further security, some programs will only operate when a security key (provided with package) is fitted to the computer.

In conclusion, by running a computerised payroll a company can perform the essential function of paying employees with more speed and accuracy than is possible by hand. It is simple to operate and payroll records are in less danger of being tampered with than they are in a locked filing cabinet.

Officemate

Micro Computer Centre has developed a modular version of its OfficeMate accounting software system which includes a payroll module.

Designed to the Inland Revenue's Specifications for Computerised Payroll, the program covers hourly, weekly and monthly paid staff on one disk.

All tax and NI codes are covered. There are five pre-tax adjustments with descriptions and five after-tax adjustments with descriptions, two of which can be pre-set in both cases. Three rates

of overtime are available and total hours of overtime at each rate are calculated.

Four options are given for running the payroll: payslip print-out after each entry; all entries first and then continuous print-out; immediate payslip print run without entries; or a selection of individual employees.

Payslips are printed out on plain paper together with a copy. Employee cost analysis in up to nine cost centres are provided. At the end of a year, the program automatically zeroes titles and P35 listings are provided. The program is suitable for contracted-out employment and mixed employment.

In the event of new legislation, Micro Computer Centre offers a service providing all the payroll updates regardless of how many there are in a year, for a fee of £50, or £25 for each payroll update required.

SuperPay

Computastore's SuperPay payroll program is designed for newcomers to computers, with memory screens guiding the user through the system.

All tax and NI codes are covered by the program which automatically calculates tax and NI for each employee for weekly, fortnightly, monthly or irregular payment periods. Up to 11 Gross Pay elements are available and five after-tax adjustments for each employee. SSP is calculated.

Pension contributions are calculated either as a percentage of gross pay or as a flat rate contribution. Flat rate or percentage Holiday Pay accruals can be accumulated and the tax week for either the whole payroll or individual employees can be advanced when holidays are taken. Holiday pay stamps which are taxable but not subject to NI can be entered.

Individual and departmental coin analyses are printed for those employees paid in cash. For those paid by credit transfer, SuperPay prints giros and summary listings. An employee's net pay can be rounded up or down to a convenient amount. SuperPay can also calculate each employee's net pay without stopping between payslips.

Totals for up to 20 rates of pay or adjustments (user-defined) are printed for up to 99 departments.

Year-end documents (P60, P11, P35) are printed for all employees including leavers.

In the event of budget increases, SuperPay automatically updates each employee's tax code by a fixed amount. PAYE and NI update disks are sent automatically to end-users for a small charge. All new versions of Superpay include Autopay as standard to cope with the major banks new regulations. 600 employees can be stored on a single disk.

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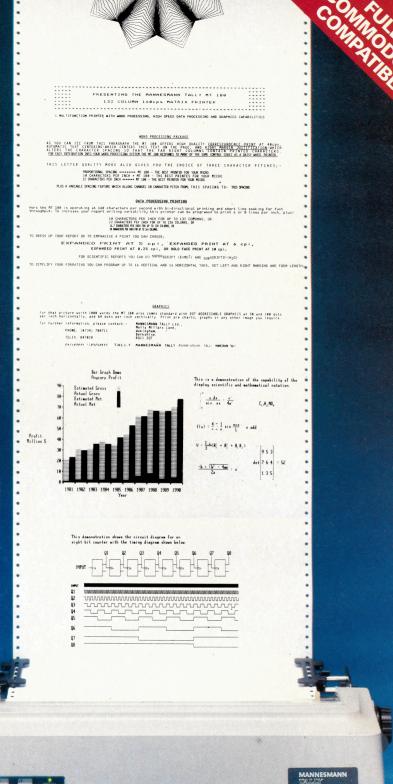
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RODUCT SUR

Integrated Tabs Payroll

Raindrop Computer's Integrated TABS payroll can be used as a discrete unit, or can be integrated with the Nominal Ledger and Job Costing modules.

The system covers nine pre-tax pay schemes. These have a number of overtime rates, bonus rates and other additions and deductions, all of which are user-defined.

There are also nine post-tax schemes, which each have five post-tax adjustments. Some of these values can be over-ridden by entries in the employee file, providing an additional choice.

Automatic calculations for tax and National Insurance are calculated according to government regulations. A choice of three types of payroll stationery is offered for payslip format. Details required to complete P45, P60, P35 and P11 forms are also available.

The payroll module includes the option to make alterations to records where operator errors are detected. Statutory Sick Pay is not catered for by this module, but Raindrop has an SSP module which can be used as a discrete module or linked to the Payroll. All functions necessary to administer the Government scheme are included in the module.

Electronics Aids Integrated Accounts System

The Integrated Accounts System from Electronics Aids incorporates a payroll program which is accessed from the pay menu. It caters for seven overtime rates defined by the user. There are two pre-tax adjustment rates and also two after-tax adjustment rates.

Deduction cards are in a similar style to the manual deduction sheets issued by the Inland Revenue. There is a choice of payroll run method; individual employee payroll run, or a full payroll run. A coin analysis is provided for cash payment. The program also provides a pay run cost analysis.

National Insurance, tax and Statutory Sick Pay can all be updated after any Budget changes, but only if there is no change to the tax system or to free pay tables.

Summaries of pay, tax and National Insurance are also available. The program does have a routine for deleting an employee who has left the company.



The employee data must remain in the program until the end of the tax year, when it can be deleted and the vacant file used for another employee.

It is impossible to access the program without the correct password. This can be changed when required. A dongle is also provided.

Payroll Plus

Landsoft have two available payroll programs, Payroll Plus being the original program and less sophisticated than its big brother Payroll 2.

Written to Inland Revenue specifications for computerised payrolls, it covers all tax codes and all NI codes. Hourly, weekly and monthly paid staff can be mixed on the same file disk in any order.

Three rates of overtime are covered, either as a percentage of the basic hourly rate or as an amount. It offers five pre-tax and five after-tax adjustments, of which two of each can be pre-set to avoid the necessity of re-entering each payday.

Access to data for manipulation is under a security password or code which can be changed when required. All employee data is easy to change.

Four choices of payroll run are offered: payslip printed out after each entry; all entries made first and then a continuous print run, immediate payslip

print run without entries; or selection of individual employees. Payslip and copy are produced side by side. Analysis after payrun is provided in each of up to 26 groups or departments, including the amount the employment has actually cost, total overtime, overall tax, NI, etc., and also a note and coin analysis.

P35 listings can be provided. At the end of the year totals can be automatically zeroed ready for the new tax year.

Landsoft offers an Update Service at a cost of £25 plus VAT a year. Whenever legislation requires, an updated program disk is dispatched which also includes any program improvements that may have been introduced.

Big brother to Landsoft's Payroll Plus program, Payroll 2 offers extra features while retaining the simplicity of operation of the original program.

Again the program covers all tax codes and all NI table letters. Hourly, weekly and monthly paid staff are mixed on the same disk. Three rates of overtime can be set by the user.

Four of the five pre-tax adjustments (including SSP) can be pre-set, while all five after-tax adjustments can be pre-set if required. Tax code changes can be globally changed.

PRODUCT SURVEY

1	Tax Wk/Mth.	Date	Dept.	Number	Company		
-	Week 21	26 Aug 83			Computastore Limit	ed	
(Rose Williams		$\bigcirc 02$	(002)			
		EMENTS:			STANDARD DEDUCTIONS:		
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	Supervisor			7.50	Tax		-45.60
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Ltd					Expenses		5.33
store					Savings		-1.00
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ight							
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31						and the same of th	Cash
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1	Taxable Gross	Gross to Date	Tax to	Date	Tax Code Total NI	NI Number	

Computastore's payslip lists each item which makes up an employee's wages.

SSP is calculated and printed on each payslip copy. The SSP paid total is held and overall totals for the year to date. Access to employee data is under a password and entry of data is to a very high degree of validation.

A choice of payroll run methods offers entries made and then continuous print out; immediate print run without entries; or the selection of individual employees. Payrun produces plain or pre-printed payslips.

Payrun analyses after each print run are provided in up to 26 different groups. which can be combined with other analyses to produce a final combined analysis.

Giro slips and cheques can be printed automatically, but if the user prefers to write cheques manually, the schedule makes the job easier.

P14, P60 and P35 listings are obtainable and at the end of the year grand totals and individual employee totals can be globally zeroed.

The system also incorporates an interrupt system whereby the computer can be used for other purposes before returning to the point of close down to continue entering. Landsoft's Update Service is also offered for Payroll 2.

Sky Software Multi-user Payroll

Sky Software, which has recently changed its name from Comsoft Associates, offers a multi-user management accounting package including a payroll program which can be operated on its own or as part of the package.

It is designed to make payroll runs as easy as possible, but provides facilities for complicated pay structures and full manual intervention if necessary.

There is no limit to the number of employees and up to 21 rates of pay and standard adjustments are covered, plus 12 occasional adjustments.

Weekly, four-weekly and monthly paid staff may be held on the same disk and sub-contract staff are catered for. Tax codes are easily updated and SSP is calculated. P60 and P45 information can be printed, and all prints may be restarted or reprinted.

Holiday pay and holiday stamp schemes are also catered for, as are any retention monies.

Correction of payment is allowed, with reports corrected for reprint after error correction. A control list is produced for checking payments before pay slips are printed.

Payment can be made by credit transfer, with a credit transfer list printed. Cheques can be printed and if paying in cash, the payroll provides a coin

A departmental analysis of costs can be produced and the whole system has password protection.

Pegasus Business Software Payroll

Pegasus Business Software's accounting system enters 1984 as one of the UK's top selling systems. It includes a payroll module which will operate alone or as part of a totally integrated accounting system.

With the Pegasus payroll system, the user designs his own payslip. It caters for up to 17 user-defined payment types and up to 17 deduction types, also userdefined. Statutory Sick Pay is catered for by this payroll system. If an employer pays staff by cash, a coin analysis is provided indicating the notes and coins required for each wage packet.

Payslips, Giros, cheques and employee's record cards may be printed at any time either for the whole file, a single employee, or a range of employees. End-of-year forms, P60's and P35's are all provided at the end of the year. Full departmental analyses are available and also an overall company analysis.

Up to 500 employees can be entered onto one disk. Employees may be removed from the file at any time, but their details will be retained until year end for statutory reports.

Pegasus' payroll module can be integrated with the nominal ledger and job costing. In this instance, any data entered onto the payroll program will automatically update related information in another module.

SPECTRUM PAYROLL

Spectrum's Payroll 8000 system is part of a comprehensive accounting suite of software. It reflects all Statutory (SSP) and Bank (Giro) regulations.

Up to four pre-set payment amounts per employee are catered for, with up to

five hourly rated entries per employee. Up to five pre-set standard deductions for each employee are available, plus an override for 'one-off' bonuses or deductions.

One data disk handles weekly, 2 weekly, 4 weekly and monthly payrolls.

The program automatically calculates PAYE and NI for employee and employer, for all different classification and codes. SSP is also calculated.

Pension contributions can be entered as either a fixed amount or calculated as a percentage of a gross pay or basic pay. Holiday pay can be paid either for the

entire payroll or to selected employees and holiday accruals can be accumulated by an employee as a percentage of a weeks gross pay or as a fixed amount.

Payment can be made by Cash, Bank Giro, Cheque or a mixture of the three. Individual and overall coin analysis is available for cash payment. Payslips, Bank Giro and Giro Schedules, Cheques and statutory Year End Forms are all produced automatically.

Departmental analysis for an overall analysis is also automatically produced. Access to the program is limited to authorised personnel.

Payroll Master

M & M Software is to launch a payroll package very shortly, called the Payroll Master. Four versions of this package will be available - V1 with a 600 file capacity and V2 with a 1800 file capacity, both of which feature manual SSP calculations; V3 with a 140 file capacity and V4 with a 500 file capacity, both featuring automatic SSP calculations.

Designed and written to comply with Inland Revenue Specifications, Payroll Master caters for all Tax Codes and NI codes (including contracted-out), Hourly, weekly and monthly paid staff can feature on the same disk.

There are three overtime rates of pay, and four pre-tax and after-tax adjustments which may be pre-set. SSP is calculated automatically.

Payroll Master provides individual and total cash analysis and cost analysis for up to 26 groups or departments.

Contractors Payroll System

FCG Computer Systems offers a payroll system designed with building contractors in mind. It operates around conventional timesheets, with time worked for each employee entered and labour costs posted to the contract cost ledger.

The system is set up in accordance with National Working Rules to automatically calculate overtime pay, sick pay, travel money, fares allowances, HWP stamp allocation and proportion of GMB. However it does accommodate variations from the NWR.

Individual sub-contractor records contain the expiry date of the C714 certificate and calculate tax at zero or 30% as appropriate. Reminders are produced three weeks in advance of expiry.



There are 26 pay elements, 10 of which can be user-defined, such as pension and court orders. PAYE is calculated and payslips are printed with a complete analysis of the pay make-up. A coin analysis is provided and also a payslip analysis summarising all payslip entries.

For each payroll run, a contract cost analysis shows cumulative and current week costs and hours worked for each trade on each contract. An employee contract analysis lists the time spent by each employee on each contract, plus the resultant cost of his labour.

At the end of the year P35 and P60's are printed out and end of year totals are automatically zeroed (pay, tax, NI, etc). Any updates in rate of pay or tax codes are globally updated.

Weekly payrun totals are printed and also the current and past months Tax and NI deductions detailing both gross (including SSP) and nett NI figures (useful for PAYE payments).

Statutory changes in Tax and NI are under user control. Instructions and data are forwarded to each user if required. Any record on file can be viewed. altered, deleted, or printed out at any time. Password protection is available if required.

menu-driven. Weekly, multi-weekly and monthly paid staff are all on one disk. The payroll can be for one, a range or all employees. Calculations can be reversed and the payroll re-run for selected employees.

SSP is calculated and an extra SSP module determines eligibility and calculates sick pay even in complicated cases. When tax codes change, the relevant data has to be entered just once and each employee's code number is automatically amended.

Changes in tax rates necessitate changes in the program itself. When changes are due, Intex Datalog provide a program which automatically updates the payroll disk. Holidays are payable in advance either by allocation of hours or

BONUS has 20 company additions/ deductions before/after tax - 10 per employee. These can be standard if required. Eleven overtime rates can be catered for, five per employee. It also has a piece-work facility. Pay rounding and cash analysis is optional and Giro and cheques can be printed.

Monthly and year-end summaries are provided and end-of-year forms are printed out. Departmental analyses are also provided. BONUS Print formats can be designed by the year. has a two-level password protection and the program will not operate without a security key being fitted to the computer.

PRODUCT SURVEY

Product survey data

Product: Spectrum Payroll 8000 Manufacturer/Supplier Spectrum Business Services, PO Box 199, Spectrum House, 27 East Parade, Bradford, West Yorkshire BD1 15R. Telephone 0274 308188.

Price: £300

Comments: Available on diskette as part of accounting suite.

Product: Payroll Master

Manufacturer/Supplier: M & M Software, Wych Elm House, The High, Harlow, Essex. Telephone 0279 39576 Price: £150-300 depending on version

Comments: Separate program on

diskette

Product: BONUS

Manufacturer/Supplier: Intex Datalog, Eaglescliffe Industrial Estate, Stocktonon-Tees, Cleveland TS160PN.

Telephone 0642 781193 Price: £400 plus VAT

Comments: Separate program on

diskette

Product: FCG Contractors Payroll Manufacturer/Supplier: FCG Computer

Systems, Hamilton House,

Mabledon Place, London WC1H 9BD.

Telephone 01-388 7345

Price: £1100

Comments: Separate hard disk program. Diskette version also available

Product: Payroll Plus

Manufacturer/Supplier: Landsoft, 28 Sheen Lane, London SW148LW.

Telephone 01-878 7044 Price: £150 plus VAT

Comments: Separate program on

diskette

Product: Payroll 2

Manufacturer/Supplier: Landsoft, 28 Sheen Lane, London SW148LW.

Telephone 01-878 7044 Price: £375 plus VAT

Comments: Separate program on

Product: Multi-user Payroll

Manufacturer/Supplier: Sky Software,

13 New Road, Bromsgrove,

Worcestershire B60 2JG. Telephone

0527 36299

Price: £350 for payroll program, £500 for

multi-user package

Comments: Separate program or part

of package on hard disk

Product: Pegasus Business Software

Manufacturer/Supplier: Pegasus Business Software, 20/22 Station Road, Kettering, Northants.

Telephone 0536 522822

Price: approximately £350 per module Comments: Separate module or part of

accounting suite on hard disk

Product: Integrated TABS Payroll Manufacturer/Supplier: Raindrop Computers, 46 Cadogan Lane, London SW1. Telephone 01-235 6286

Price: £250

Comments: Separate module, or integrated into accounting package, on

Product: Integrated Accounts System Manufacturer/Supplier: Electronics Aids, Mythe Crest, The Mythe, Tewkesbury, Gloucestershire GL20 6EB.

Telephone 0684 294003

Price: £400 plus VAT

Comments: Part of accounts package

on diskette

Product: Officemate

Manufacturer/Supplier: Micro Computer Centre, 28 Sheen Lane, London SW14. Telephone 01-878 7044

Price: £325 plus VAT

Comments: Payroll module on diskette

Product: Superpay

Manufacturer/Supplier: Computastore,

16 John Dalton Street, Manchester M2 6HG. Telephone 061 832 4761 Price: £395 plus VAT.

Comments: Separate program on

diskette

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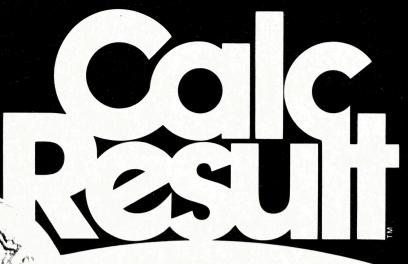
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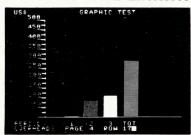
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APPLICATIONS

Commodore's PET

The cost of re-equipping a research laboratory with the latest microprocessor-controlled instrumentation can be astronomical, and, in the University sector at any rate, the necessary finance is not available. However, many older pieces of apparatus can be given a new lease of life by using them with a dedicated on-line microcomputer. Many of the advantages and facilities of a new instrument may, in this way, be obtained at a fraction of the cost. In this article Dr Alan Collins describes some of the areas of research in which Commodore computers are being used in the physics department at King's College London.

The physics research department at King's College London has used Commodore computers to control instruments, and collect and process data, since the PET 2001-8 was first introduced in 1978. This early PET was the first self-contained modestly-priced microcomputer on the British market that gave the user access to the address and data buses.

Two research students at King's College - Ricardo Rodrigues and Peter Siddons (now both PhD's) - developed a memory-mapped interface for the PET 2001, containing two 6522 VIA's and up to 3K of EPROM, which was located in the block 9 address space (see Journal of Physics E (1979), Vol. 12, pp.403-408). This interface, which is also suitable for the CBM 3000 and 4000 series computers, is configured to provide a 16 bit data bus, an 8 bit control bus and an input and output handshake line.

This permits operating up to 256 different data-handling modules, each capable of working to 16-bit precision. Typical modules are 3, 4 and 8 phase stepper motor drives, 16-bit counter, 12-bit analogue to digital convertor (ADC) and digital to analogue convertor (DAC), mains-synchronised clock and various electro-mechanical devices. Machine-code routines to handle the input and output functions are contained in the on-board EPROM and are selected by a series of USR calls.

Similar hardware, driven from the IEEE port, is now available commercially, but the early impetus given by the Rodrigues-Siddons interface has resulted in five different research groups in the department using Commodore computers to run experiments and process the data.

Machines from the 2000/3000, 4000, 8000 and 9000 series are currently in operation. Some systems still use the original interface while others input and output data via the IEEE bus (GPIB).

A Bus Operating System (BOS) has been developed which allows any apparatus with an IEEE port to be successfully interfaced to the computer and which greatly speeds up data transfers to and from GPIB instruments such as the Commodore disk drive. (For example a 4000 point integer array can be written on the disk in less than seven

For many applications the processing power of the Commodore machine is adequate, but when substantial "number crunching" is required data files are sent to a PDP 11/44 - and from there to the University of London Computer Centre if necessary. The RS232 link to the PDP 11/44 uses either a NETKIT in the CBM, or the built-in ACIA in a 9000 series PET, driven by our own file-transfer program which uses a check-sum to ensure there are no errors. Alternatively data can be transmitted using a Small Systems Engineering IEEE to RS232 convertor.

Experiments

In almost every experiment the results are finally summarised as a "spectrum" or graph in which one variable is plotted against another. The related variables may be X-ray intensity and angle, transmission and wavelength, electron energy and voltage, signal amplitude and time, and so on. Brief details of the way the microcomputers are used in these investigations are given below.

X-ray diffraction

When a suitably cut crystal is placed in a narrow beam of X-rays, the X-rays are diffracted in directions which depend on the structure of the crystal, the wavelength of the X-rays and the angle between the crystal and the incident beam. In a simple experiment the crystal is mounted on a platform which can be rotated by a stepper motor and the diffracted X-ray beam is detected by a stationary geiger counter.

The number of counts from the geiger counter, recorded in a fixed time interval, will depend on the angle between the crystal and the X-ray beam. The experiment can be completely automated by registering the pulses from the geiger tube on a 16-bit counter and driving the stepper motor, both by means of the interface described earlier.

After a fixed time interval controlled by the computer the reading from the counter is transferred to memory, the counter is reset to zero, pulses are fed to the stepper motor to rotate the crystal slightly and the sequence restarted. At the end of the experiment the array of numbers stored in the computer can be processed to show a graph of diffracted X-ray intensity as a function of angle. Hard-copy is produced on a Hewlett-Packard plotter connected to the IEEE port.

Silicon

More sophisticated X-ray diffraction studies use single crystals of silicon which act as X-ray interferometers. Some of these crystals must be cut to very elaborate shapes. This is carried out by moving the sample in three perpendicular directions using a micropositioner fitted with three stepper

APPLICATIONS

fit for King's

motors driven by the computer, and grinding the silicon away with a dental drill. Many samples of great complexity can be reliably and reproducibly fabricated by this technique.

Optical absorption

A great deal can be learned about processes in crystals from the wavelengths at which the material absorbs light. For wavelengths to which the eye is sensitive this absorption affects the colour observed, but important information is also obtained from studies in the ultraviolet and infrared regions.

A spectrum can be produced by using a monochromator in which the incoming light is split up into different wavelengths with a diffraction grating. When the grating is rotated, the different wavelengths fall in turn on a detector which produces an analogue signal proportional to the intensity of the light at that wavelength.

For computer operation the signal from the detector is read by a 12-bit ADC and the grating is either rotated by a stepper motor driven from the interface, or by a synchronomous motor, in which case data transfers are timed with the mains-synchronised clock. The first method allows repetitive scanning to be carried out which is useful in some applications.

Initially an incident-light spectrum is recorded with no sample present and the 3000 to 4000 12-bit numbers are stored in memory. After inserting the sample the transmission spectrum is recorded over the same wavelength range. At each point the absorbance is calculated by taking the LOG of the ratio of the two spectra and, after scaling, is plotted against wavelength on an X-Y plotter, using a two-channel 12-bit DAC.

Software for the plotter, including a vector generator and generation of a limited number of symbols, is contained in an EPROM. The final spectrum can be stored in a few seconds on floppy disk, for future reference.

The use of the Commodore 3000 in this application has greatly speeded up what used to be a tedious manual analysis of analogue chart recorder output, and many hundreds of spectra have been obtained in this way.

Fourier-transform spectroscopy

Another method used to obtain optical absorption spectra, particularly in the infrared spectral region, uses an interferometer rather than a monochromator. In the interferometer the incoming light is split into two beams, then these two beams are recombined at the detector, using a system of mirrors.

When one of the mirrors in one beam is moved at a slow steady rate, in a direction perpendicular to the beam, the signal from the detector, plotted against time, is a series of fringes. The absorption spectrum can be calculated from this fringe pattern using a mathematical technique known as Fourier transformation.

Using a commercially available ROM (from Structured Software) which carries out a fast Fourier transform (FFT), absorption spectra can now be obtained, plotted out on a Commodore printer, in a few minutes. As in other applications the analogue signal from the detector is sampled using a 12-bit ADC, and between each reading the mirror is moved using a stepper motor driving a precision lead screw.

This on-line analysis has completely replaced the earlier procedure in which data on punched paper tape was processed by the University of London Computer Centre.

Radio wave propagation

The FFT technique is also used in a CBM-controlled system dedicated to an analysis of "atmospherics". For a short-wave listener atmospherics are the annoying clicks and crackles which interfere with the station of interest. However, from a Fourier analysis of the waveform of an atmospheric, which shows how the signal varies with frequency, a great deal can be learned about the electrically active layers in the Earth's ionosphere, and how these influence the propagation of radio waves. (Without these layers, long distance radio communication would not be possible).

To carry out the analysis three signals derived from the atmospheric are digitized and stored in a three channel × 1024 word Datalab Transient Recorder. These data are then transferred to the CBM and, after preliminary signal

processing, waveforms are sent to a Hewlett-Packard spectrum analyser which obtains spectra using a hardwired FFT.

These spectra are returned to the CBM for final processing, and parameters calculated are output to a CBM printer, a Christie digital cassette and a CBM disk drive. All data transfers are via the GPIB.

Photo-electron spectroscopy

When a gas molecule is illuminated with very short wavelength ultraviolet light it may be ionized, giving out an electron. The energy of this electron is well defined and is characteristic of the molecule being investigated.

To measure the electron energy the electron is made to follow a curved path between two curved metal plates which have a voltage difference between them. If the voltage between the deflector plates is correct the electron will reach a detector. This is an electron multiplier (or channeltron), and after amplification the signal from the channeltron is converted into an analogue voltage proportional to the number of electrons collected per second.

In the spectrometer controlled by a PET this analogue voltage is digitized by a CIL microsystems PUPI interface. The interface also generates the scan voltage for the spectrometer deflector plates, and the digitized photoelectron signal is stored at fixed intervals of the scan voltage. At the end of the scan the energy of the electron can easily be determined from the array of stored data.

The computer-controlled digitallygenerated scan voltage is very much more flexible than the electronicallyderived ramps used previously, and the storage of the spectra on disk allows the data to be processed in more detail after the experiments have been completed.

In conclusion, Commodore computers are used to control experiments and collect and analyse data in the physics research department at King's College London. The computers either use an interface designed here, or commercial interfaces or other equipment connected to the IEEE port. These dedicated on-line computers have greatly increased the speed and convenience with which our results can be obtained.

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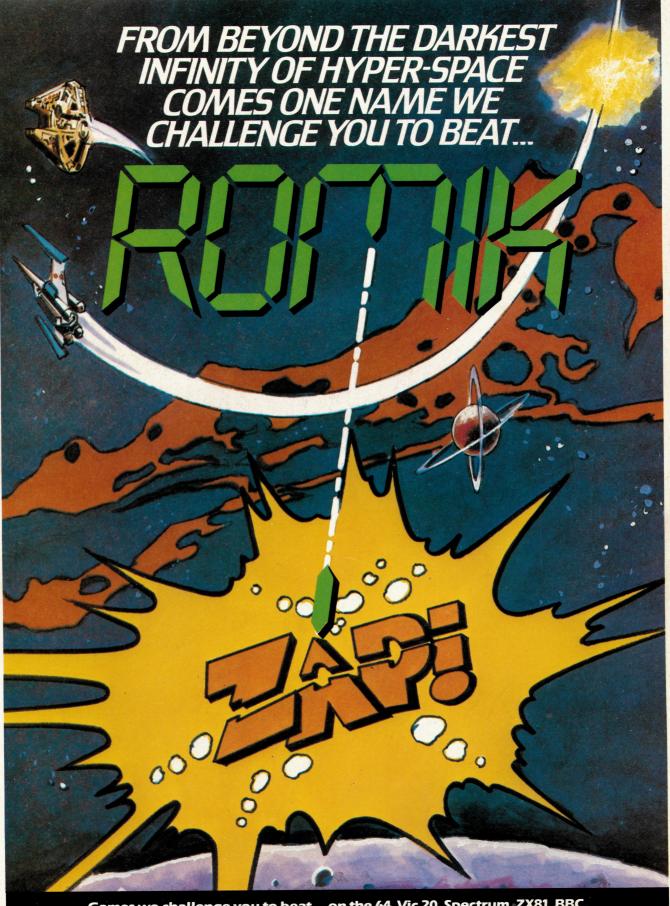
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